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TRAINING ASSESSMENT AND MODELING SUBJECTIVE DATA ENCAPSULATION FOR THE NATIONAL TRAINING CENTER

by

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The National Training Center (NTC) located at Fort Irwin, California performs the critical Army mission of preparing battalion task forces and brigade staffs for combat. The NTC provides a unique opportunity to assess training proficiency. To assist in the training assessment of rotating units, the Army has spent millions of dollars on a state of the art instrumentation system that transmits objective data from all player vehicles and stores the information in a database. Currently, no subjective observer-controller (O/C) observations of training are stored in the database. The primary emphasis of this research is to develop a training assessment system and model subjective data encapsulation to enhance training performance analysis. The assessment system is designed to be incorporated into a relational database that will allow analysis of various measures of performance that provide input for platoon through brigade level After Action Reviews (AAR). Additionally, the database will support methods for simple data manipulation for the purpose of conducting post-rotation analysis and the identification of trends.

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TRAINING ASSESSMENT AND MODELING SUBJECTIVE DATA ENCAPSULATION FOR THE NATIONAL TRAINING CENTER

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ABSTRACT

The National Training Center (NTC) located at Fort Irwin, California performs the critical Army mission of preparing battalion task forces and brigade staffs for combat. The NTC provides a unique opportunity to assess training proficiency. To assist in the training assessment of rotating units, the Army has spent millions of dollars on a state of the art instrumentation system that transmits objective data from all player vehicles and stores the information in a database. Currently, no subjective observer-controller (O/C) observations of training are stored in the database. The primary emphasis of this research is to develop a training assessment system and model subjective data encapsulation to enhance training performance analysis. The assessment system is designed to be incorporated into a relational database that will allow analysis of various measures of performance that provide input for platoon through brigade level After Action Reviews (AAR). Additionally, the database will support methods for simple data manipulation for the purpose of conducting post-rotation analysis and the identification of trends.

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EXECUTIVE SUMMARY

The National Training Center (NTC) located at Fort Irwin, California performs one of the most important missions in the United States Army - that of preparing battalion task forces and brigade staffs for combat. The NTC provides a unique opportunity to assess training proficiency. Its large maneuver training areas and world class opposing force (OPFOR) allow for full scale battalion force-on-force operations. During the past 16 years, the Army has added a computer-driven, live-fire complex with sophisticated targetry and a state of the art instrumentation system.

The current instrumentation system stores data transmitted by player vehicles in an antiquated *Ingres* database. These data, along with subjective observations of the observer-controllers (O/Cs), provide the input for platoon through brigade level After Action Reviews (AARs) that focus on cause and effect. Currently, no subjective O/C observations are stored in the database. The few tasks evaluated by O/Cs are scored on a "yes", "no", or "nts" (not to standard) scale.

The NTC requires the identification of tasks that should be evaluated to provide meaningful feedback to the rotating unit (BLUEFOR). This research proposes a selected group of tasks based upon the seven Battlefield Operating Systems (BOS), current Mission Training Plans (MTPs), and the Critical Combat Functions (CCFs). Additionally, selected data that are currently collected by O/Cs are also included.

The performance measurement system proposed in this research is a five-point-graphic rating scale using behaviorally anchored words. Additional evaluation categories are included to account for potential holes in the data which could affect the validity of the data. The implementation of the system will be in the form of O/C evaluation cards that are organized by unit echelon and BOS. Each O/C will be required to carry and fill out only one card and the cards are independent of the type of mission.

This research proposes the use of semantic objects to encapsulate the subjective O/C observations and allow them to be stored in the relational database being implemented at the NTC. An example graphical user interface (GUI) is provided that will enable Tactical Analysis and Feedback (TAF) analysts to interact with the database to input data as well as make queries to the database to generate AAR reports. The AAR reports display numerous measures of performance (MOP) for each BOS. The MOPs are designed to serve as a tool for the O/Cs to initiate relevant discussion during AARs.

The MOPs and data collected on the O/C evaluation cards will support post-rotation analyses. The post-rotation analysis can focus on identifying the training deficiencies within one unit or analysts can use basic statistical techniques to identify the systematic shortcomings of all units across all rotations.

The greatest strength of all these methodologies is that they are simple. They involve the examination of training by BOS and by unit echelon, techniques already in use at the NTC. Graphical user interfaces are recommended to enable every analyst to have the ability to input data into the database as well as query the database for information to produce specific reports. Additionally, when mathematics are introduced, only simple, commonly understood statistics are recommended for root cause analysis and trend identification.

I. INTRODUCTION

A. GENERAL

The National Training Center (NTC) at Fort Irwin, California performs one of the most important training missions in the United States Army - that of preparing battalion task forces and brigade staffs for combat. During the past 16 years, the Army has added a computer-driven, live-fire complex with sophisticated targetry; a full-time opposing force (OPFOR) that is trained and equipped with Soviet-style equipment and can replicate a range of possible regional threats; a state of the art instrumentation system that monitors the battle; and 800 full-time combat trainers who observe and control units during training at Fort Irwin.

The Range Data Management System (RDMS) is a state of the art instrumentation system that transmits objective data from all player vehicles in a rotating unit (BLUEFOR) to the Core Instrumentation System (CIS) where the data are stored in a database. These data, along with the subjective observations of the observer-controllers (O/Cs), provide input for platoon through brigade level After Action Reviews (AARs) that focus on cause and effect. For each engagement, soldiers and leaders assess what happened, why it happened, and determine how to improve their battlefield skills.

B. PROBLEM DESCRIPTION

The CIS stores data transmitted by the RDMS in an antiquated *Ingres* database which has been both extensively and exclusively modified by the NTC for use by Tactical Analysis and Feedback (TAF) center analysts. Currently, no subjective O/C observations are stored in the database. O/C observations are displayed on *Harvard Graphics* slides during AARs. When a subjective observation requires an evaluation of performance, O/Cs use a "yes", "no", or "nts" (not to standard) categorical rating scale. Rotating units are not given the specific observations that led to the O/C evaluation on a particular area of performance and usually gain little constructive information from the assessment.

O/C observations are also written in narrative form for inclusion in the Take-Home Package (THP) that is produced for each rotating unit. Upon the conclusion of a rotation at the NTC, two sets of THPs are prepared. Each TAF produces a THP that is given to the BLUEFOR unit for use at home station. Generally, this unit THP consists of copies of all the slides shown at the AARs and a video tape copy of all AARs. No standard exists for these THPs and they vary greatly between the TAFs. Civilian contractors, with input from the TAFs, produce another THP consisting of the executive summaries of the various battles. This THP is sent to the Center for Army Lessons Learned (CALL) at Fort Leavenworth, Kansas for archival purposes and post-rotation analysis. In general, the unit THPs are not used to a wide extent at home station, nor is the executive summary version useful to analysts at the Center for Army Lessons Learned.

C. SCOPE OF THESIS

The NTC is implementing a new relational database application in *Oracle* that will efficiently store both RDMS and O/C data. Concurrent efforts in a Naval Postgraduate School thesis titled *Modeling Data Encapsulation and a Communication Network for the National Training Center, Fort Irwin, CA* address the design of the new database for objective data elements [Ref. 1]. The primary purpose of this research is to identify the aspects of unit performance that can be evaluated subjectively by O/Cs at the NTC for use during AARs and inclusion into unit THPs. A methodology for making quantitative assessments of unit performance will assist in the determination of cause and effect and will benefit the Center for Army Lessons Learned for post rotation analysis.

D. THESIS STRUCTURE

The next chapter of this thesis gives a brief overview of NTC operations and explains the integration of the RDMS currently being used. Chapter III details subjective O/C data requirements and proposes a methodology for evaluating subjective observations. Chapter IV offers methodologies for developing quantifiable measures of performance and the incorporation of O/C data into a relational database. This chapter also outlines how the O/C evaluations relate to post-rotation analysis and the development

of trends. Chapter V discusses conclusions and provides recommendations for further research.

II. BACKGROUND

A. GENERAL

Twelve times a year, Army units from all over the United States travel to Fort Irwin, located in the Mojave Desert, for National Training Center (NTC) rotations. A typical rotation lasts twenty-four days and involves several days of equipment issue, followed by fourteen days of intensive force-on-force and live-fire training. The units then spend time cleaning up, turning in equipment, and returning to their home stations.

Each rotation brings 3500 to 5000 soldiers who represent major combat, combat support and combat service support elements of an Army brigade. The troops arrive by air at various locations in California and Nevada and are transported by bus to Fort Irwin. They transport unit vehicles and equipment by rail to the Yermo Railhead located along Interstate 15, north of Barstow, California. Upon arrival, the soldiers prepare their equipment and draw additional material from the extensive array of pre-positioned hardware that is maintained at Fort Irwin.

B. INSTRUMENTATION

The purpose of the training at the NTC is to identify areas in which rotating battalion task forces and brigade staffs must improve. The goal of the Observer/Controllers (O/C) is to assist the BLUEFOR unit in that purpose by providing subjective observations on all training conducted. To assist with the collection of objective observations, the Army has spent millions of dollars in instrumenting the NTC in order to provide the best possible feedback. Vehicles and personnel at the NTC are equipped with the Multiple Integrated Laser Engagement System II (MILES II) which is an eye-safe laser system that simulates combat engagements. MILES II, an upgrade of MILES I, adds new features that allow for additional information gathering. Like MILES I, MILES II allows one combat system to "kill" another system through the emission of a laser beam. The detector belts on a vehicle being fired upon measure the strength of an incoming beam and if it is located within the maximum effective range of the firing vehicle,

a "hit" is registered. The MILES II system then runs through a stochastic simulation to determine the outcome of the engagement with the assistance of pre-determined probabilities of kill. One of six outcomes is possible: near-miss, hit, catastrophic kill, communications kill, mobility kill, or a firepower kill. MILES I simply returned a near miss or a kill. Under the old system, when a vehicle was killed, the OC would assess the type of kill and would dictate whether or not the vehicle could continue in the battle.

In addition to the MILES II, the NTC mounts several other instrumentation devices on the vehicles. The Global Position Satellite (GPS) receiver records the location of the vehicle on the battlefield. The Simulated Area Weapons Effects (SAWE) receiver simulates the effects of indirect fire and chemical munitions strikes. The Mines Effects Simulator (MES) receiver simulates the effects of damage sustained due to minefields. Three additional instrumentation systems measure the hull to turret angle, the type of ammunition selected for an engagement, and the number of rounds of ammunition by type currently on board each vehicle.

All of these systems feed information into a "brain box" located on each vehicle called the Data Communications Interface (DCI). The DCI transmits data over the recently upgraded Range Data Management System (RDMS), which consists of the DCI, a Radio Relay Subsystem (RSS) and the central node. The DCI transmits data upon the occurrence of an event. Events include the vehicle firing, the vehicle moving more than 100 meters, or the vehicle being engaged by an enemy vehicle. Additionally, if more than ten seconds has elapsed since the DCI last transmitted data, it sends an update to the central node. The central node is a hardware and software subsystem that links the RSS to the Core Instrumentation System (CIS). The CIS takes the information received from the central node to create a computerized picture of the battlefield that displays vehicles moving, vehicles firing, and vehicles being engaged by other vehicles. This animated war is superimposed on a computerized terrain map of the NTC that includes the operational graphics of the BLUEFOR unit and manual inputs that allow minefields, chemical strikes, and artillery fire missions to be displayed almost as soon as they occur during the battle.

The CIS stores the raw data received from the central node into an *Ingres* database for the purpose of reports generation and the archiving of information for further analysis.

III. TRAINING ASSESSMENT

A. NEED FOR TRAINING ASSESSMENT

Training performance feedback is essential in maximizing the benefit of any training endeavor. Systematic measurement and subjective observations by subject matter experts (SMEs) are required to accomplish this mission. Accurate measurement of combat effectiveness has been recognized by the Army as critical to three objectives: (1) determining the combat readiness of units; (2) assessing the training status of units and identifying subsequent training requirements; and (3) identifying improvements to doctrine, training, organization, material, and leadership [Ref. 2].

The National Training Center (NTC) provides a unique opportunity to assess training proficiency. Its large maneuver training areas and world class opposing force (OPFOR) allow for full scale battalion force-on-force operations. For many battalions, an NTC rotation is the only opportunity during a calendar year to train as a combined arms team with all its attachments against a skilled, free-thinking opponent.

The NTC has over 800 full-time Observer/Controllers (O/Cs) and has an instrumented data collection system that allows for the real time gathering of objective information. O/Cs provide subjective observations during the AARs and provide subjective comments for inclusion in the Take-Home Packages, but they conduct very little quantitative assessment.

B. CONCEPTUAL METHODS

The Army Research Institute (ARI) has conducted significant research focusing on how to capture data at the NTC and convert it into a useful format that training analysts can use for study and analysis. The principal model used to direct the ARI research program is shown in Figure 1 [Ref. 3].

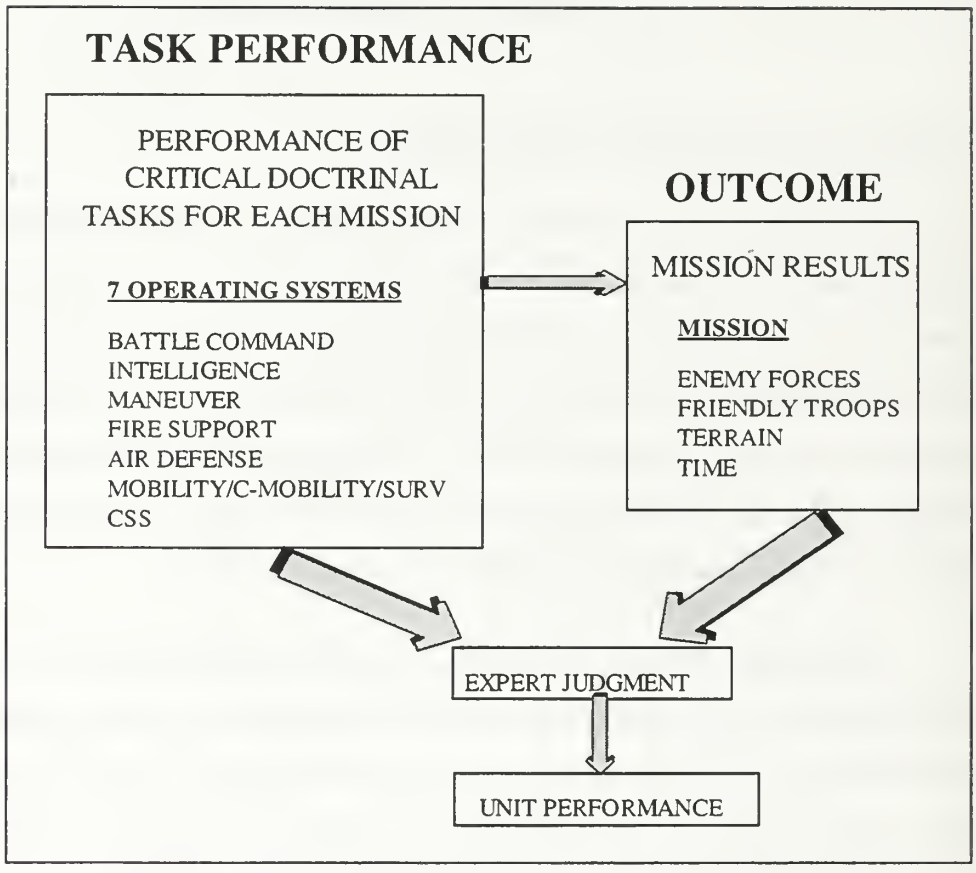


Figure 1. Training Assessment Model.

The majority of the research effort focuses on methods using the various Army Mission Training Plans (MTPs) as the core documents in developing a measurement strategy. The MTPs in their current form are considered by many to be impractical to use for assessing collective performance, particularly in advanced training environments like the NTC, so modifications are necessary [Ref. 3].

Subject matter experts (SMEs) from the Infantry School, Armor School, NTC, and the Combined Arms Center identified tasks at platoon, company, and battalion levels that are considered to be critical in the accomplishment of the four principal missions at the NTC: movement to contact, hasty attack, deliberate attack, and defend. Tables 1,2,and 3 display the number of critical tasks identified by element size and Battlefield Operating System (BOS), the major functions performed by Army forces to execute Army operations.

	INT	MAN	FS	ADA	M/CM/S	CSS	BC	Total
Planning	12	21	7	7	9	5	23	84
Preparation	9	9	6	7	7	10	13	61
Execution	7	19	5	2	7	6	8	54
Total	28	49	18	16	23	21	44	199

Table 1. Battalion Critical Tasks.

	INT	MAN	FS	ADA	M/CM/S	CSS	BC	Total
Planning	11	26	10	2	6	6	25	86
Preparation	5	8	9	2	5	6	10	45
Execution	4	19	2	2	5	6	11	46
Total	20	53	21	6	16	18	46	177

Table 2. Company Critical Tasks.

	INT	MAN	FS	ADA	M/CM/S	CSS	BC	Total
Planning	6	21	5	2	5	2	21	61
Preparation	3	11	3	1	6	3	10	37
Execution	2	21	2	2	6	4	10	47
Total	11	53	10	5	17	9	41	145

Table 3. Platoon Critical Tasks.

The SME panel significantly reduced the number of tasks listed in the MTPs, but the lists are still extensive. For a platoon conducting a hasty attack, an O/C would have to evaluate the tasks listed in Figure 2.

HASTY ATTACK - MISSION TASKS

2	Conduct Terrain Analysis
3	Identify Enemy Strengths and Weaknesses
4	Plan for Mutual Support
5	Plan Movement
6	Plan Actions on Contact
9	Plan Reorganization
11	Plan Air Defense Measures
13	Plan for NBC Operations
14	Understand Commander's Intent
15	Understand Control Measures
18	Plan Redundant Communications
19	Plan Fire Control and Distribution Measures
21	Conduct Battlefield Update
23	Disseminate Fire Support Plan
25	Conduct Pre-Combat Checks
26	Prepare for NBC Operations
27	Establish Redundant Communications
30	React to Unexpected Enemy Contact
31	React to Change in Situation
32	Conduct Fire and Movement
33	Conduct Assault
34	Acquire and Engage Targets
35	Conduct Consolidation
36	Execute Fire Support Plan
37	Support Breaching Effort
38	Conduct Breach of Obstacle
39	Reorganize Assets
40	Conduct Evacuation Procedures
41	Respond to NBC Operations
42	Maintain Communications
43	Control Fires
44	Maintain Lateral Contact with Adjacent Units
56	Plan Evacuation Procedures
68	Rehearse Reactions to Enemy Air
79	React to Enemy Air
92	Control Movement
93	Coordinate Plans with Lateral Units
94	Maintain Communications
95	Designate a Support by Fire Element
96	Designate Consolidation Procedures
97	Verify Supporting Fires
98	Establish Lateral Contact with Adjacent Units
99	Supervise the Implementation of Plans and Orders
100	Designate Battle Drills and Procedures
101	Establish Fire Support Communications
102	Prepare for Breaching Operations
103	Move to Assault Position
107	Maintain Operations Security
111	Mark Breach
114	Disseminate Intelligence and Combat Information
115	Report Combat Information
116	Update Estimate of the Situation
123	Report On-Hand Status
126	Issue Warning Order
127	Conduct Mission Analysis
128	Initiate Planning Process
129	Conduct Briefbacks
130	Refine Plan
131	Issue FRAGO
132	Comply with Commander's Intent

Figure 2. Platoon Hasty Attack Critical Tasks.

To add to the complexity of this system, numerous schematic wiring diagrams were developed to identify which tasks should be evaluated by mission. The wiring diagrams further divided the three phases of a battle typically discussed at NTC (planning, preparation, and execution) into even smaller phases. Figure 3 shows the wiring diagram for the execution phase of a platoon hasty attack. The task numbers listed in the diagram are the tasks shown in Figure 2 [Ref. 3].

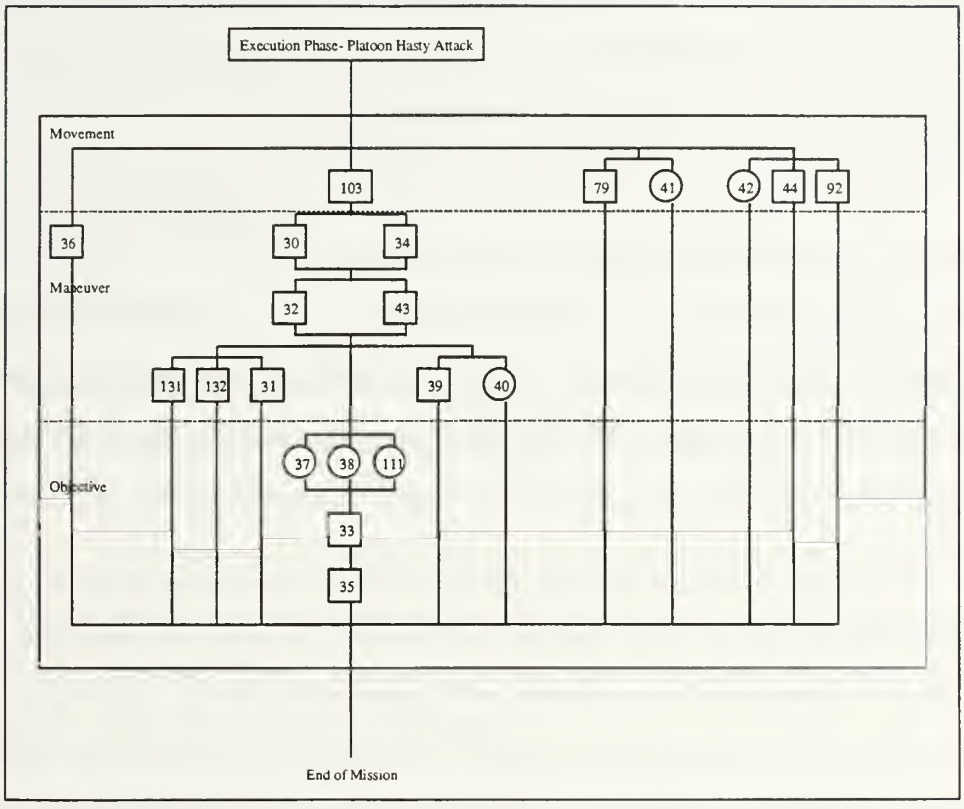


Figure 3. Execution Phase- Platoon Hasty Attack.

C. SHORTFALLS

1. Measurement

The NTC has accomplished its goal of providing realistic combat training, but some feel that the data available are not adequately being used to identify general training weaknesses throughout the Army [Ref. 4]. To measure combat effectiveness, O/Cs have to measure a unit's performance within the framework of established doctrine. Unfortunately, the translation of doctrine into identifiable, measurable performance standards is an extremely difficult task. Unit training manuals avoid precise specification of performance standards for maneuver units and concentrate instead on task performance procedures. The omission of standards for successful performance is understandable as training exercises are conducted on various types of terrain, during radically different weather conditions, and during both daylight and periods of limited visibility. Exercises also feature opposing forces of different sizes, skill level, equipment, and motivation [Ref. 5]. Additionally, when examining collective unit performance, it is often difficult for the

observer to know which is collective performance and which is the result of aggregate individual performances [Ref. 6]. All of these factors contribute to the training measurement problem being faced by our modern army.

O/Cs can generally categorize a unit as effective or ineffective, but they usually are not able to substantiate their opinions with any form of precise data. This drawback is analogous to the Heisenberg Uncertainty Principle, a measurement problem in physics. Its three premises are that the process of measurement dynamically affects the object being measured, that the object has varying states of existence, and that the object is known only through measurement.

In the case of the first premise, special training conducted in preparation for an NTC rotation and actions taken because a unit knows it is being observed by O/Cs often result in performance that is inconsistent with typical unit performance. Personnel turbulence and turnover, as well as casualties sustained during simulated combat are factors that correspond to the second premise. Units are not fixed entities, but change in composition over time. Finally, because accurate measurement of combat effectiveness is difficult to obtain at home station, measurements taken at a training facility like the NTC often provide the best indicators of unit's effectiveness. However, these indicators only hold when the measurement was made [Ref. 5].

2. Subjective Data

The NTC collects enormous amounts of objective data over the RDMS, but uses very little of the data in its current form because the database is incapable of providing quality training feedback to the O/Cs for use in unit AARs. These objective data, though used infrequently, are considered by some to be valuable in that they are not subject to O/C bias or interpretation. Others believe that subjective measures are often superior because many facets of performance can be integrated into an overall judgment [Ref. 6].

O/Cs use very little subjective data during the AARs. Subjective observations are generally geared toward preparation for combat tasks, such as rehearsals, operations orders and pre-combat inspections, and O/Cs assess units on a "yes", "no", or "not to

standard" scale. Failure to use more extensive subjective observations eliminates performance measurement for some key areas such as decision making and cognitive skills [Ref. 6]. The only record of any observations in these areas is in the form of narrative comments that are included in unit THPs and analysts are forced to sift through voluminous pages to find them.

3. Reliability

Measurement reliability is an important, yet commonly overlooked dimension of performance measurement. Without adequate reliability, measurement is useless. Two kinds of reliability, inter-observer reliability and stability, are critical to quality training measurement. Inter-observer reliability is the extent to which two or more observers produce similar results in measurement and stability is the extent to which measures taken at one time are representative of measures taken at other times [Ref. 6]. The O/Cs play a key role in establishing measurement reliability.

All measurements that involve human beings making assessments are subject to the biases of the evaluator. Because rating performance is a complex task, raters have the opportunity to make errors. Subjective evaluations of training performance can often be biased by impressions of effort, rather than being pure measures of achievement [Ref. 6]. Other potential subjective evaluation problems identified are in Table 4 [Ref. 7].

Error	Effects
Leniency	Ratings tend to be displaced toward favorable end of scale.
Sequential Effects	Judgment of an item on the rating scale is affected by the items which precede it.
Distribution Error	Ratings tend to pile up in the middle of the response distribution.
Intercorrelational Error	The halo effect in which the rating on one characteristic spills over to affect ratings on other characteristics which are distinctly different.

Table 4. Rating Errors.

Training the O/Cs in the measurement system and making them aware of the potential pitfalls can help alleviate these problems.

4. NTC Organizational Culture

Many of the problems with training evaluation at the NTC stem from the deep-rooted organizational culture that permeates the NTC. There is tremendous organizational resistance amongst the O/Cs to any measurement system that attempts to evaluate a unit or involves any form of doctrinal checklist recording form. The O/Cs at the NTC claim they do not compare units and that the NTC is a *training center* not a *testing center*. The belief that a unit cannot be trained properly if attempts are made to evaluate its performance has led to years of poor data collection and analysis. The result has been a general failure to identify the root causes behind numerous training deficiencies and has led Army units to deploy to the NTC and continually make the same mistakes.

The O/Cs at the NTC are among the finest officers and non-commissioned officers in the Army. They have all served, commanded and excelled in the types of units they evaluate and are the tactical and doctrinal subject matter experts (SMEs) in their respective areas. The feeling amongst O/Cs is that the AAR is the premier feedback mechanism for units during their rotation and most military professionals agree. The AAR will last for two hours at company and battalion levels and one hour at platoon level. Typically, that only allows enough time for the O/Cs to highlight the most significant training shortcomings and often focuses only on areas of performance that the unit can attempt to improve upon for the next battle in the rotation. Many pertinent O/C observations are never discussed due to the limited duration of the AAR and are only recorded if the O/C remembers to include the observations in the THP.

5. Practicality

There are numerous problems with past attempts to measure training performance at the NTC. Many of the proposed methods are simply too lengthy and too complicated. They involve endless checklists with missions broken down into tasks and subtasks, each with numerous standards. It is often unclear which portions of which checklists should be filled out. There is also a problem when a task included in the checklist is not performed by the unit or is performed out of sight of the O/C. If the O/C fails to note that the task

was not observed and leaves that portion of the checklist blank, there is now an unexplainable hole in the data which directly affects the data's validity.

The current checklist systems typically call for the data recording forms to be filled out only one time, usually upon completion of a particular phase in the battle. This forces the O/C to make one subjective evaluation of a task even though the task may have been performed numerous times, or continually over time. This type of evaluation system does not allow O/Cs or analysts to make time period specific queries to the database in order to determine what areas of performance significantly influenced various portions of the battle or how performance on a group of tasks may have been related.

D. METHODOLOGY FOR MEASUREMENT SYSTEM

1. General

The NTC requires a system for training performance measurement that: 1) records pertinent subjective evaluations by O/Cs, 2) can be rapidly placed in a database, 3) provides useful input into AARs and THPs, 4) assists analysts in post-rotation analysis, and 5) is easily executable by O/Cs. Although all of the above requirements are important, ease of execution by O/Cs is paramount.

The job of an O/C at the NTC is extremely demanding. Units that rotate through the NTC fight simulated battles in M1 Abrams Tanks and M2 Bradley Fighting Vehicles (BFVs). Rotations will sometimes include the addition of a light infantry battalion. As units maneuver across the NTC in their tracked combat vehicles, O/Cs follow along in tactical wheeled vehicles. In the case of light infantry battalions, O/Cs walk with the unit they are observing. Any performance measurement system to be implemented at the NTC must not interfere with the O/Cs principal duties of observing and controlling and from a safety standpoint, must not impede the O/Cs ability to maintain his situational awareness. During simulated battles, obscurants such as blowing sand and smoke make maneuvering along side 70-ton combat vehicles extremely hazardous.

2. System of Systems Methodology

Critics claim that the Mission Training Plans (MTPs) are too detailed to serve as an appropriate measurement system and that the Battlefield Operating Systems (BOS) are oriented at higher level units. However, both of these tools are valuable because they document training in terms of our current doctrine.

The foundation of the system of systems methodology is the seven BOSs: Intelligence, Maneuver, Fire Support, Mobility/Countermobility/Survivability, Air Defense, Combat Service Support, and Battle Command. The methodology is based upon the premise that maneuver ground warfare is a system consisting of seven subsystems, the BOSs, all of which must be integrated and function in a satisfactory manner for the larger system to function properly. The same premise holds true for all BOSs. Each BOS has subsytems that must function properly in order for the BOS to have its full impact on the battle being waged. The Critical Combat Functions (CCF), outlined in TRADOC PAM 11-9, are used to bridge the gap between the BOSs and MTPs and provide a useful method to categorize performance at the battalion level. At levels below battalion, selected tasks from the MTPs as well as data that are historically collected by O/Cs are grouped by BOS and serve as the primary evaluative tools.

For example, maintenance is one subsystem of the BOS Combat Service Support. Often times, a battalion's Operational Readiness (OR) rate is used as the sole measure of effectiveness (MOE) to describe a unit's maintenance posture. This is a simplistic approach which does nothing to analyze the root causes of any maintenance problems. The methodology proposed in this research breaks these BOS subsytems down by unit size, the concept being that the maintenance procedures followed at platoon and company levels can have enormous impact on the battalion's overall maintenance posture. Figure 4 illustrates the methodology.

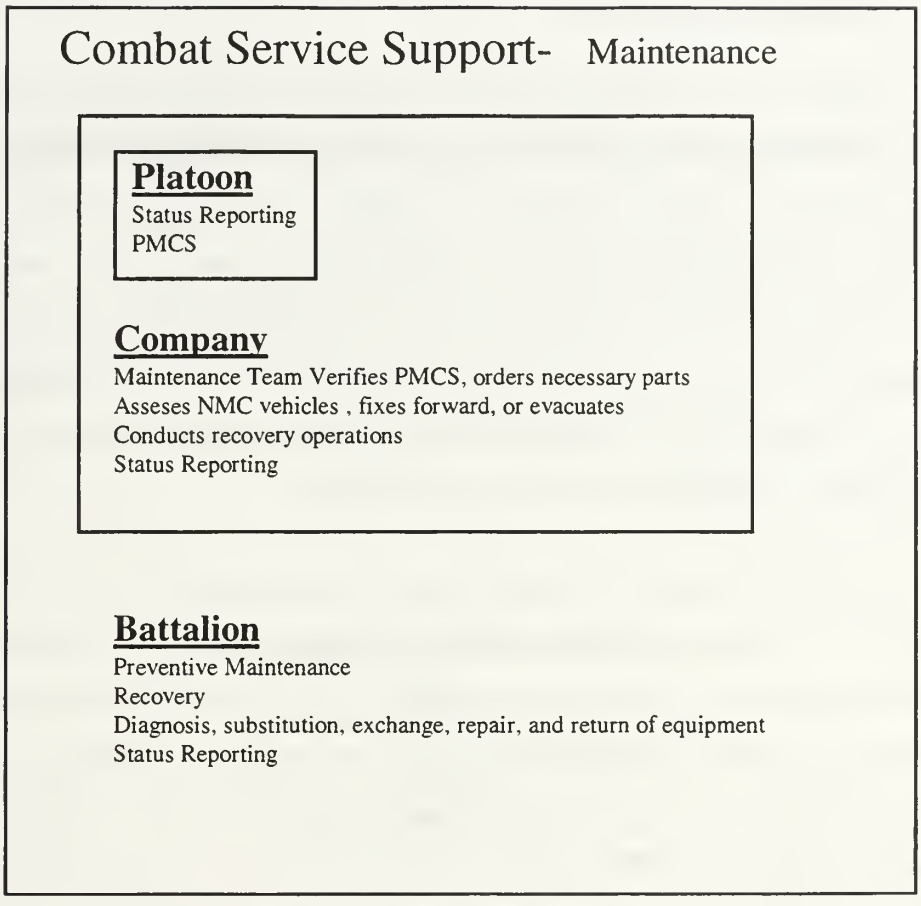


Figure 4. System of Systems Approach.

Certain tasks, such as status reporting in the case of maintenance, are common to units at every level. Other tasks take place only at one level, yet can impact the overall system. A low OR rate may be a function of parts not being put on order when needed at the company level as opposed to operators not performing preventive maintenance checks and services (PMCS) on their assigned equipment or a poorly performing battalion maintenance section. Therefore, if a measure of effectiveness, such as a unit's OR rate, indicates a maintenance shortcoming in the unit, the database can be queried to show O/C evaluations of all related tasks throughout the battalion. These queries will provide information that will assist O/Cs and analysts in determining the contributing factors to the maintenance problem.

3. Subjective Evaluation

Critical to the functionality of an O/C's observations is the measurement system used to describe the rotating unit's performance. Standard Army training protocols use simple evaluation systems. Tasks listed in MTPs are evaluated on a "trained", "needs practice", or "untrained" scale while the subtasks are evaluated on a "go" or "no go" basis [Ref. 8]. These two measurement systems are not specific and do not provide the O/C with enough choices to properly discriminate a unit's performance. The differences between a "needs practice" evaluation and an "untrained" evaluation are not adequately delineated because neither standard is clearly defined.

Fort Polk, Louisiana's Joint Readiness Training Center (JRTC), a training center similar to NTC developed for light infantry units, uses the tasks and subtasks listed in the MTPs as its performance measurement system. O/Cs at JRTC are given "greenbooks" that contain only the MTP tasks pertinent to the given mission. All tasks are evaluated on a five-point ordinal scale using behaviorally anchored words [Ref. 9]. This is similar to the approach used during a RAND study of the effects of direct fire planning conducted at the NTC in 1994. Figure 5 shows the similarities of these two systems.

The system proposed in this research is a similar type of measurement system with minor modifications. O/Cs will evaluate tasks on a five-point graphic rating scale using behaviorally anchored words. Each numerical rating will have an evaluative measure and a standard associated with it. This is a modification of standard graphic rating scales which typically do not use associated standards [Ref. 7]. In addition, other evaluation categories are included to account for any potential holes in the data so that the validity of the data is not called into question during analysis. The proposed evaluation system is shown in Table 5.

JRTC MEASUREMENT SYSTEM

Rating	Description	Standard
1	Poor	Unit completely lacked technical and tactical proficiency to perform this task to standard.
2	Weak	Unit attempted to perform task but lacked technical and tactical proficiency to meet all standards.
3	Adequate	Unit demonstrated technical and tactical proficiency to perform this task to standard.
4	Good	Unit demonstrated technical and tactical proficiency to perfom task and exceeded some standards.
5	Excellent	Unit demonstrated technical and tactical proficiency to perform task and exceed most standards.

RAND MEASUREMENT SYSTEM

Rating	Description
1	None
2	Inadequate
3	Moderately Adequate
4	Adequate
5	Superior
N/A	Not Applicable

Figure 5. Current Measurement Systems.

Rating	Description	Standards
0	None	Unit failed to execute a task that was demanded by the tactical situation.
1	Poor	Unit completely lacked technical and tactical proficiency to perform this task to standard.
2	Weak	Unit attempted to perform task but lacked technical and tactical proficiency to meet all standards.
3	Adequate	Unit demonstrated technical and tactical proficiency to perform task to standard
4	Good	Unit demonstrated technical and tactical proficiency to perform task and exceeded some standards.
5	Excellent	Unit demonstrated technical and tactical proficiency to perform task and exceed most standards.
N/A	Not Applicable	The tactical situation did not demand the unit to perform this task.
N/O	Not Observed	The tactical situation made it impractical for the O/C to observe this task.

Table 5. Proposed Evaluation System.

The evaluation system in scale form is shown in Figure 6. When the scale is based on the numbers 1 through 5 (1-7, 1-9 etc.), it is commonly referred to as a Likert-type scale and the intervals represent supposedly equal orders of magnitude of some measure. Research has shown that there is little utility in having more than five scale categories [Ref. 7].

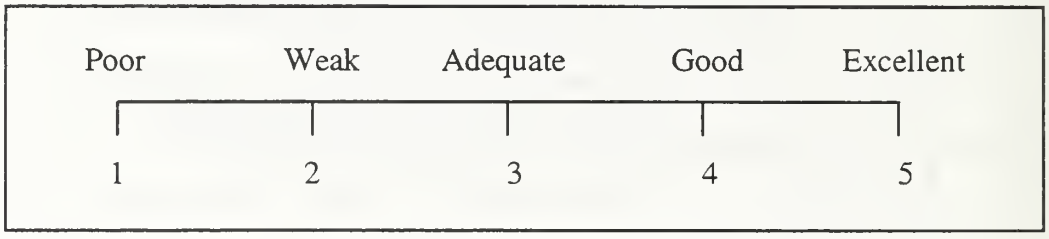


Figure 6. Graphic Rating Scale.

This type of scaling instrument provides analysts with ordinal data. Table 6 shows the properties of different scales of measurement [Ref. 10].

Scale	Basic Empirical Operations	Permissible Statistics	Examples
Nominal	Determination of Equality	Number of cases Mode Contingency correlation	Football jersey numbers Car model numbers
Ordinal	Determination of greater or less	Median Percentiles Order correlation	Hardness of materials Grades of leather IQ test raw scores
Interval	Determination of the equality of intervals or differences	Mean Standard deviation Product moment correlation	Temperature (Celsius) Calendar time Potential energy
Ratio	Determination of the equality of ratios	Geometric mean Harmonic mean Percent variation	Length, density Loudness (sones) Brightness (brils)

Table 6. Scales of Measurement.

The rating scale described in this research was designed under the assumption that the "distance", or the difference in level of training, between any two numbers on the rating scale are equal. This is not an unusual assumption as many scaling instruments assume that the rater is capable of rating or sorting on an equal interval scale [Ref. 11]. Experimental data often approach the condition of equal intervals well enough that there is tolerable error in applying the statistics applicable to interval data. Guilford agrees that these approximations are allowable in order to extract the most information from the data, but cautions that "intolerable approximations" should not be accepted [Ref. 12]. Additionally, once sufficient rotation data are available, methods described in the Law of

Categorical Judgment can be used to test the validity of the assumption. These methods are derived by assuming that the frequencies with which discriminal processes are associated with any given stimulus form a normal distribution [Ref. 11].

4. Implementation

The implementation of the methodology will be in the form of performance evaluation cards. The system is designed so that an O/C will only have to carry and fill out one card, regardless of the type of mission. It makes no difference whether it is an offensive or defensive operation, or whether it is conducted during force-on-force or live-fire operations. The cards to be carried by the platoon and company O/Cs are shown in Figure 7 and Figure 8, respectively. The battalion level BOS cards are in Appendix A.

Mission DATK MTC DEF LF FOF
TF_____CO_____PLT_____ TD_____

		Observation
	Intel	
1	Dissemination of intel to subordinates	0 1 2 3 4 5 N/A N/O
2	Reports all enemy activity to higher	0 1 2 3 4 5 N/A N/O
	Maneuver	
3	Battle drills execution, mounted	0 1 2 3 4 5 N/A N/O
4	Battle drills execution, dismounted	0 1 2 3 4 5 N/A N/O
5	Movement formations	0 1 2 3 4 5 N/A N/O
6	Movement techniques	0 1 2 3 4 5 N/A N/O
7	Fratricide prevention	0 1 2 3 4 5 N/A N/O
	Battle Command	
8	Platoon SOP execution	0 1 2 3 4 5 N/A N/O
9	Net discipline	0 1 2 3 4 5 N/A N/O
10	Fire control SOP's	0 1 2 3 4 5 N/A N/O
11	Control of dismounts	0 1 2 3 4 5 N/A N/O
	M/CM/S	
12	M-8 emplaced	0 1 2 3 4 5 N/A N/O
13	# dismounted fighting positions to std	____/____
14	# vehicle fighting positions to std	____/____
15	Hasty protective minefields	0 1 2 3 4 5 N/A N/O
16	Manual breaching techniques	0 1 2 3 4 5 N/A N/O
17	Vehicle breaching techniques	0 1 2 3 4 5 N/A N/O
	Fire Support	
18	Target list disseminated	0 1 2 3 4 5 N/A N/O
19	Priority of fires understood	0 1 2 3 4 5 N/A N/O
20	Call for fire	0 1 2 3 4 5 N/A N/O
21	Location of FIST and mortars	0 1 2 3 4 5 N/A N/O
22	FS net freqs and callsigns	0 1 2 3 4 5 N/A N/O
	Air Defense	
23	Air guard SOP	0 1 2 3 4 5 N/A N/O
24	AWS/WCS understood	0 1 2 3 4 5 N/A N/O
	CSS	
25	Status reporting	0 1 2 3 4 5 N/A N/O
26	PMCS	0 1 2 3 4 5 N/A N/O
27	Buddy aid/combat lifesaver	0 1 2 3 4 5 N/A N/O
		0 1 2 3 4 5 N/A N/O
	Prep for Combat	
28	Boresight	0 1 2 3 4 5 N/A N/O
29	C/PCI	0 1 2 3 4 5 N/A N/O
30	Class III/V upload	0 1 2 3 4 5 N/A N/O
31	Rehearsals	0 1 2 3 4 5 N/A N/O
32	Safety/risk assessment	0 1 2 3 4 5 N/A N/O
33	Warning Order	0 1 2 3 4 5 N/A N/O
34	Operations Order	0 1 2 3 4 5 N/A N/O
35	Task of Interest 1	0 1 2 3 4 5 N/A N/O
36	Task of Interest 2	0 1 2 3 4 5 N/A N/O
37	Task of Interest 3	0 1 2 3 4 5 N/A N/O

38 Freeform 1 _____

_____

_____

39 Freeform 2 _____

_____

_____

Figure 7. Platoon O/C Evaluation Card.

Mission DATK MTC DEF LF FOF
TF_____CO_____ TD_____

Intel	Observation
40 Performs Co Level IPB	0 1 2 3 4 5 N/A N/O
41 Disseminates intel to subordinates	0 1 2 3 4 5 N/A N/O
42 Assesses local enemy situation and reports	0 1 2 3 4 5 N/A N/O
43 Company R & S planning	0 1 2 3 4 5 N/A N/O
Maneuver	
44 Engagement area preparation	0 1 2 3 4 5 N/A N/O
45 Direct fire planning	0 1 2 3 4 5 N/A N/O
46 Actions on contact	0 1 2 3 4 5 N/A N/O
47 Movement formations	0 1 2 3 4 5 N/A N/O
48 Fire Control and distribution	0 1 2 3 4 5 N/A N/O
59 React to indirect fire	0 1 2 3 4 5 N/A N/O
50 Fratricide prevention	0 1 2 3 4 5 N/A N/O
51 Consolidate and Reorganize	0 1 2 3 4 5 N/A N/O
52 # dismounts engaged in fight/total dismounts	____/____
Battle Command	
53 Co SOP Execution	0 1 2 3 4 5 N/A N/O
54 Commander's estimate process	0 1 2 3 4 5 N/A N/O
55 Mission analysis	0 1 2 3 4 5 N/A N/O
56 Decides on need for action or change	0 1 2 3 4 5 N/A N/O
57 Co Net discipline and crosstalk	0 1 2 3 4 5 N/A N/O
M/CM/S	
58 Breach Obstacles	0 1 2 3 4 5 N/A N/O
59 Emplacement of mines and complex obstacles	0 1 2 3 4 5 N/A N/O
60 Physical security measures	0 1 2 3 4 5 N/A N/O
61 Hasty Deocn	0 1 2 3 4 5 N/A N/O
62 Unmasking procedures	0 1 2 3 4 5 N/A N/O
Fire Support	
63 Positioning of FIST	0 1 2 3 4 5 N/A N/O
64 Co fire plan and target list	0 1 2 3 4 5 N/A N/O
65 Designation of priorities of fire	0 1 2 3 4 5 N/A N/O
66 Call for Fire	0 1 2 3 4 5 N/A N/O
Air Defense	
67 Employment of organic weapons aganst enemy air	0 1 2 3 4 5 N/A N/O
68 Early Warning	0 1 2 3 4 5 N/A N/O
69 Cover and concealment	0 1 2 3 4 5 N/A N/O
CSS	
70 Status reporting	0 1 2 3 4 5 N/A N/O
71 Necessary classes of supply on-hand	0 1 2 3 4 5 N/A N/O
72 Maint Tm verifies PMCS and orders parts	0 1 2 3 4 5 N/A N/O
73 Assesses NMC vehicles, fixes forward, or evacs	0 1 2 3 4 5 N/A N/O
74 Recovery operations	0 1 2 3 4 5 N/A N/O
75 CASEVAC plan	0 1 2 3 4 5 N/A N/O
76 # DOW/ #Casualties	____/____
Prep for Combat	
77 Backbriefs	0 1 2 3 4 5 N/A N/O
78 Rehearsals	0 1 2 3 4 5 N/A N/O
79 Safety/risk assessment	0 1 2 3 4 5 N/A N/O
80 Warning Order	0 1 2 3 4 5 N/A N/O
81 Operations Order	0 1 2 3 4 5 N/A N/O
82 Task of Interest 1	0 1 2 3 4 5 N/A N/O
83 Task of Interest 2	0 1 2 3 4 5 N/A N/O
84 Task of Interest 3	0 1 2 3 4 5 N/A N/O

85 Freeform 1 _____

86 Freeform 2 _____

Figure 8. Company O/C Evaluation Card.

All evaluation cards will contain three tasks of interest to be evaluated during a rotation. The tasks of interest will be designated by the appropriate level of leadership at the NTC and should remain constant through the course of a rotation. The purpose of these tasks is to give the O/Cs the ability to track the performance of units on tasks that are not listed on the cards, but that the O/Cs believe are important. The NTC maintains a list of tasks and combat functions which units typically do not perform in a satisfactory manner. These tasks of interest could be used to divide a poorly performed task down into its most basic components at each level of command in an attempt to isolate the root cause of the poor performance.

The cards also contain two freeform comment blocks. The freeform comments should be brief, no more than two or three sentences, and should be filled out at the conclusion of a battle. The purpose of the comment blocks is to provide the O/C with the opportunity to identify two aspects of unit performance, either in a positive or negative manner, that had a direct impact on the particular unit or staff section's performance.

A significant weakness of current systems is that these systems only record one evaluation of task performance on tasks that are executed repeatedly or continually. The evaluation system proposed in this research overcomes this by taking into account the time that an observation is made and allows the O/C to change his evaluation over time. The O/C can change his evaluation any time he notices a change in performance and should reaffirm certain evaluations at critical points in a battle, such as a unit coming under fire from enemy vehicles, a unit hitting an obstacle, or a unit encountering a chemically contaminated area. By associating a time with each observation, queries can be made to the database by unit and period of time which will assist both O/Cs and analysts in finding the root causes of training deficiencies.

The recording of multiple O/C observations of one task over time will require the assistance of analysts in the Tactical Analyst and Feedback (TAF) facility. Every O/C has a counterpart analyst in the facility that prepares AAR slides and computerized pictures of the battlefield. The O/C has a reliable and immediate radio communications link to his

counterpart and they communicate frequently during the course of a battle. The O/C will be able to call in his evaluations to his analyst who will enter the data into the database. This method is recommended to ease the burden on the O/C who may not have the opportunity to record an observation due to the tactical situation. It also does not distract him from his primary mission of observing and controlling units.

Although the method calls for all observations to be time tagged, the O/C should still fill out a final assessment, using the same evaluation card, at the end of the battle. The reason for this is that there may be certain areas of performance that were not evaluated during the course of a battle and there are certain objective O/C collected data that are only available at the end of a battle such as the number of personnel that are assessed as "died of wounds" and the final OR rate of a unit. The O/C directed end-of-mission time should be the time placed in the database for final observations.

Additionally, manually filling out the cards will provide analysts with training evaluation data in the event that there are hardware or software problems with the database or if the CIS is down for maintenance. The manual filling out of the cards should not, however, preclude the O/C from calling in his final assessments to his TAF analyst. The TAF analyst should have ample time prior to the task force AAR, conducted six hours after end-of-mission, to input the data so queries can be made to the database for the purpose of reports generation.

In order for O/C subjective evaluations to be an integral part in the NTC's goals of reversing trends and conducting quality AARs, the data must be captured and stored in a usable form. Benson developed a relational database to store the objective data transmitted over the RDMS. This database can also be used to store O/C subjective evaluations. The next chapter provides a brief discussion of relational databases and proposes a methodology for generating reports that can be used to facilitate the AAR process.

IV. SUBJECTIVE DATA ENCAPSULATION AND MOP DEVELOPMENT

A. SUBJECTIVE DATA ENCAPSULATION

The database being implemented at the NTC is a semantic object model first presented by Kroenke in 1988. The basic component of the model is the semantic object, a "named collection of attributes that sufficiently describes a distinct identity" [Ref. 13]. Semantic objects model user requirements more realistically than previous methods.

1. Semantic Objects

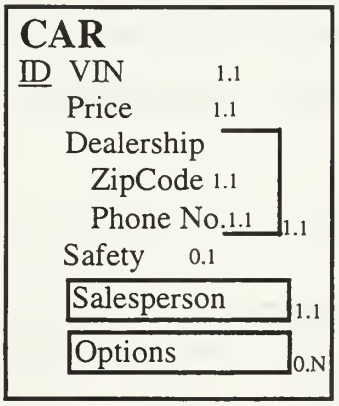


Figure 9. Semantic Object.

Semantic objects are representations of distinct identities. Attributes describe the object and can have various cardinalities. Figure 9 represents an object called CAR. The Vehicle Identification Number (VIN) is the object identifier. JMC1212AS3453 is an example instance of the object. A simple attribute of CAR is price because it has a single numerical value. Dealership is a group attribute containing dealership, zip code, and phone number. Salesperson is an object attribute that establishes a relationship between one semantic object and another.

Each attribute of an object has a maximum and minimum cardinality. Minimum values are typically 1 or 0. If the minimum is 0, then no value is required. If it is 1, then it must have a value for the object to be valid. In the CAR example, a car may or may not have any options, yet there must be a VIN. The maximum cardinality is the maximum

number of instances of the object. Generally, it is either 1 or N (several). If it is 1, then the object can have only one instance. If it is N, then the attribute can have a range of values. In the CAR object example, numerous options are accommodated, yet there is only one Salesperson. Every attribute has a range of possible values called a domain which can be numeric, string, or enumerated [Ref. 1].

2. Subjective Data Objects

Relational databases require transformations of semantic objects to facilitate platform implementation. Two-dimensional tables containing data, called relations, are developed from semantic objects. There are seven types of semantic objects which can be manipulated to form relations. Benson provides examples of several types of transformations. In his proposed database for the NTC, Benson introduces two objects of interest that are critical to subjective data encapsulation. Figure 10 shows the two objects [Ref. 1].

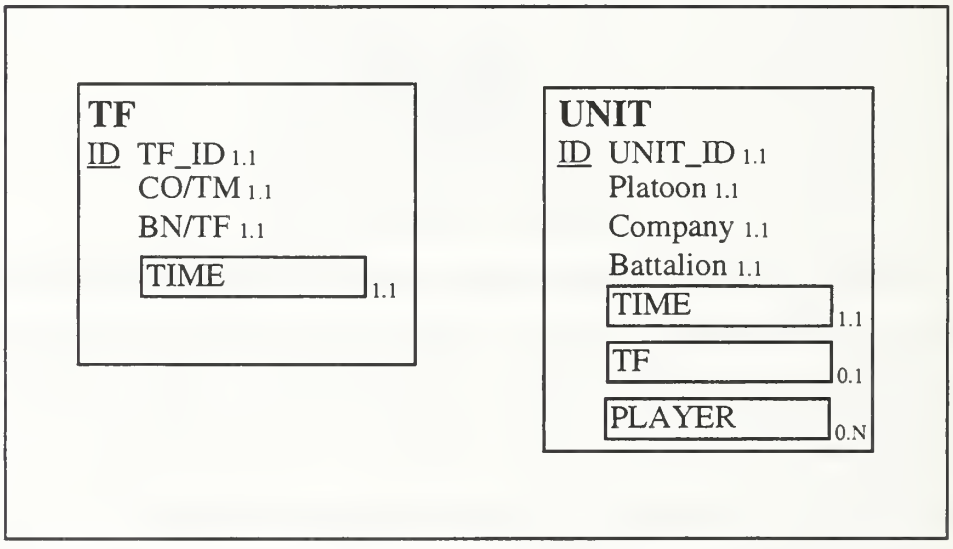


Figure 10. Proposed Database Objects.

Two additional objects are proposed in this research to serve as the vehicles for representing subjective data in the database. Figure 11 shows the objects used to model O/C subjective data requirements. The Co/Plt Report object will model data from the Company and Platoon O/C cards and the BOS Report object will model data from the task force level BOS cards.

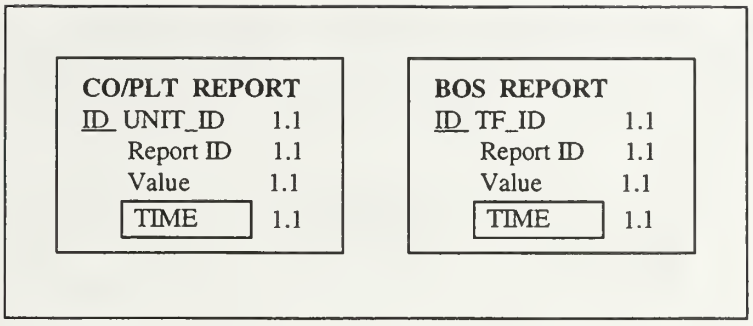


Figure 11. Subjective Data Semantic Objects.

The two objects, along with the Task Force and Unit objects, can be transformed into relations which will record the data in tabular form. The transformation of these objects is shown schematically in Figure 12.

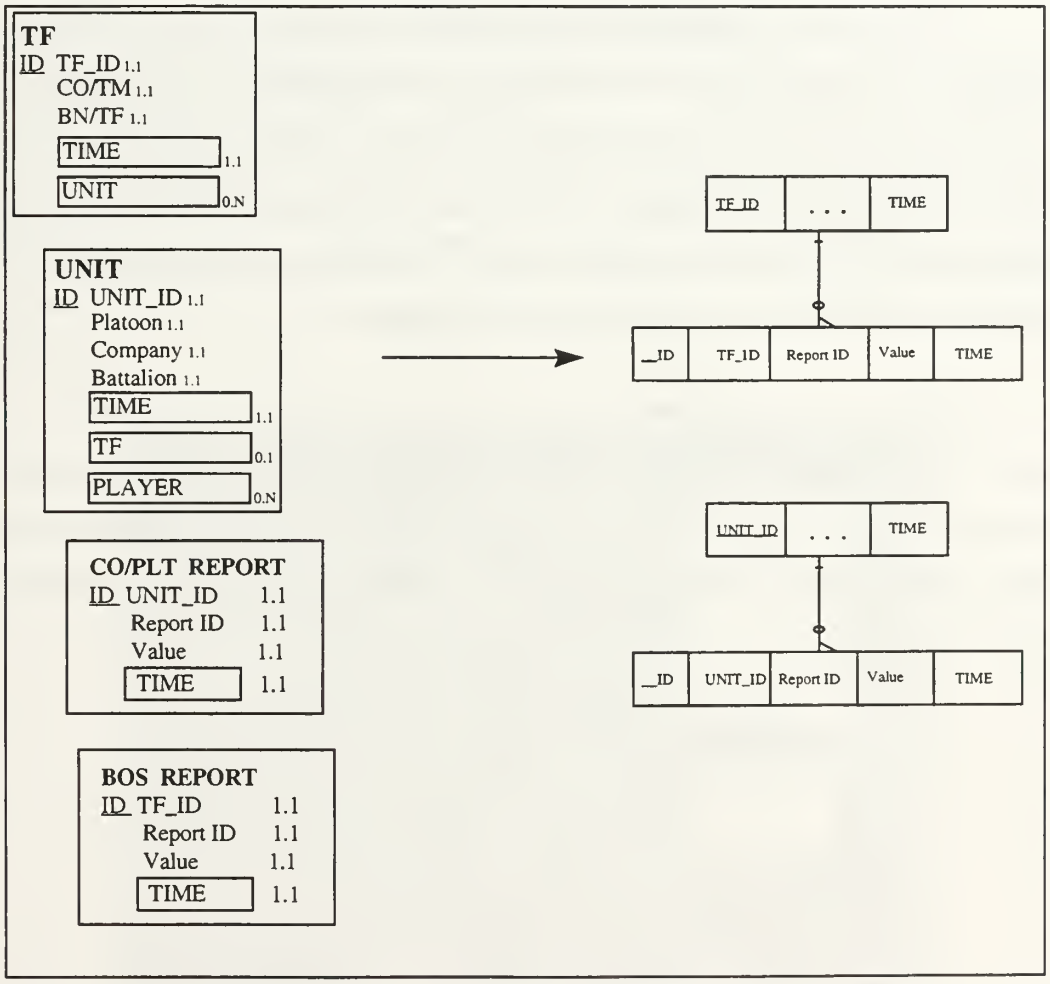


Figure 12. Object Transformations.

Table 7 shows an example relation with sample data. "__ID" represents a surrogate key that is automatically entered by the database to make each row of the table unique.

_ID	UNIT_ID1	Report ID	Value	TIME_ID1
1	1	40	2	1203
2	1	54	2	1203
3	2	74	3	1206
4	1	2	2	1323
5	2	7	4	1345
6	2	15	3	1438

Table 7. CO/PLT Report Relation.

3. Graphical User Interface

In order for the proposed system to work, there must be human interaction with the database to input subjective O/C observations. Databases are complex mechanisms and relatively few people possess the knowledge necessary to manipulate them. This research proposes using a graphical user interface (GUI) that will allow TAF analysts to input subjective O/C data with minimal effort. This GUI should be embedded in a software application that can interact with the database.

Three frames of a sample GUI are displayed in Figures 13, 14, and 15, respectively. This sample GUI was written in Borland *Delphi 2.0* and is organized in the same manner as the proposed evaluation system and the AARs. This familiar construction by unit and battlefield operating system should facilitate the employment of this system by the TAF analysts.

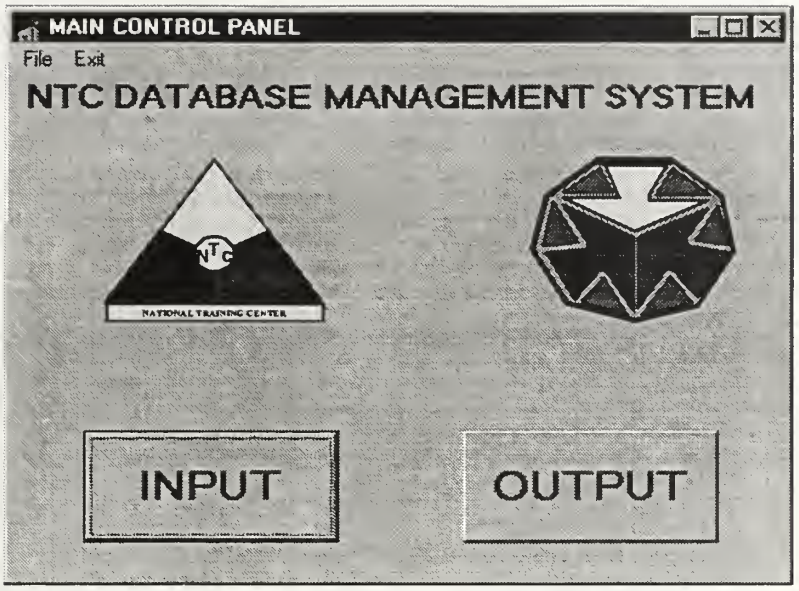


Figure 13. Main Control Panel (GUI).

Figure 13 shows the first frame of the GUI which simply allows the TAF analyst to input or query data necessary to generate an AAR report. In this example, the input button was selected. Figure 14 shows the next screen in the data input sequence. This screen allows the analyst to select the BOS, unit echelon, and the specific unit for whom the data will be inputted. In this example, the Mobility/Countermobility/Survivability (M/CM/S) BOS was selected for A/2-18 AR, a tank company.

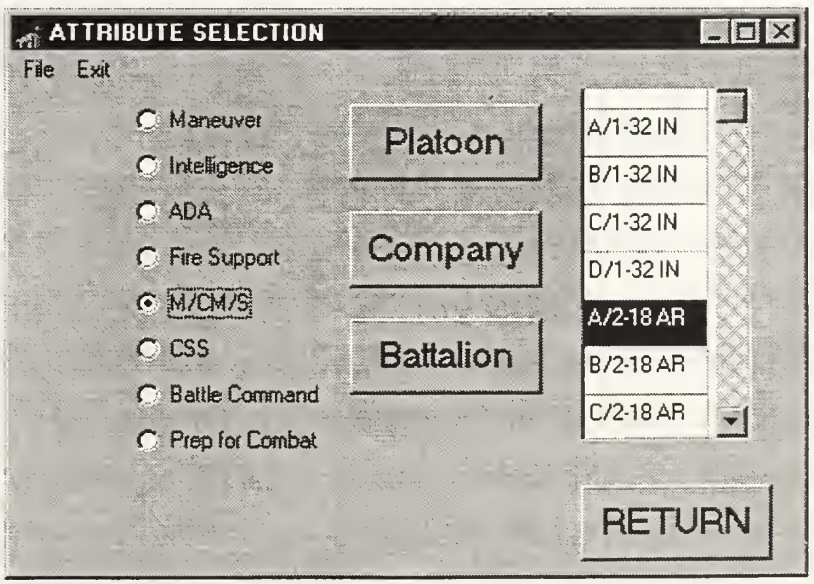


Figure 14. Attribute Selection (GUI).

Figure 15 shows the final input screen. Because the M/CM/S BOS was selected in conjunction with the selection of a company-sized unit, the input screen displays the tasks listed in the M/CM/S section of the Company O/C card. Figure 15 indicates that evaluations and observation times for three executed tasks are being placed in the database for A/2-18 AR.

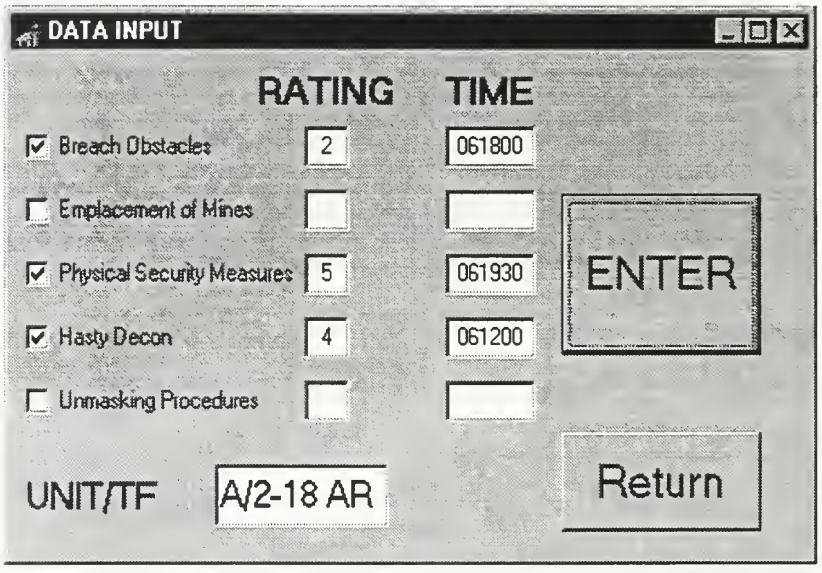


Figure 15. Data Input (GUI).

B. MOP DEVELOPMENT

O/C feedback provided during AARs and in unit THPs is critical to improving unit performance at the NTC. The AARs focus on what happened, why it happened and how the unit can improve. The O/Cs begin the AAR process with a specific agenda detailing the aspects of the battle they want to discuss. One goal of the O/C is to get the BLUEFOR to initiate the relevant discussion. Often times, the unit is reluctant to offer substantial comments or embarks down a path of discussion that the O/C believes is not productive.

This research proposes using performance indicator reports as a tool for the O/C to use to get BLUEFOR units to initiate relevant discussion. The reports are generated by making queries to the database and include both subjective O/C data as well as objective

data provided by the RDMS. The reports are broken down by BOS which makes incorporation of the reports into the AAR a simple task.

The reports themselves are measures of performance within a specified BOS. They will typically yield a numeric value and certain values are preferred over others. For example, a unit desires a low "died of wounds" rate in the BOS CSS while at the same time it desires a high operational readiness (OR) rate. If a unit has a high "died of wounds" rate, that is an indication that there is a problem with the unit's casualty evacuation or medical treatment systems. Conversely, a high OR rate indicates a strong performance in maintenance.

Unlike the training evaluation system where a rating of 5 always indicates excellent performance and a rating of 1 always indicates poor performance, regardless of the task, the MOPs vary. For some MOPs, high values are preferred, and for others, low values are desired. Although this may seem inconsistent, the MOP design is intentional in order to discuss training in the vernacular of the combat units that rotate through the NTC. Army units discuss casualties in terms of the percentage of soldiers who die as a result of their wounds and not the percentage of soldiers who do not die from their wounds. This inconsistency is tolerable because BLUEFOR units and O/Cs will have no difficulty interpreting the results.

There is no requirement from the NTC to combine the individual measures of performance of a specific BOS into an overall measure of effectiveness (MOE) for that BOS. If desired in the future, analysts can simply take the converse of MOPs where low values are preferred to obtain consistent MOPs where high values are always best. Analysts can then apply various weighting techniques or other methods to develop an overall MOE for any BOS. However, it is not practical, or desired, to combine measures of performance of different BOSs in an attempt to develop one, single measure of effectiveness for a unit's performance. Researchers have attempted in the past to use the loss-exchange ratio (LER) as an overall measure of effectiveness. This often presents skewed data because the LERs of battles conducted at the NTC are highly dependent

upon when the O/Cs stop a particular battle. If a battle was stopped because the forward companies in a defense were attrited and the reserve company was too far back to get into the fight, a higher LER will be obtained than if all companies had been engaged. Artillery accuracy also affects the LER. Simulated artillery at the NTC lands precisely on the coordinates given in the call for fire. This greatly favors the OPFOR whose knowledge of the terrain results in more accurate calls for fire. Another problem arises because the engagements are conducted with MILES. The OPFOR trains about 100 days a year with MILES whereas BLUEFOR units only train with MILES about 25 days per year [Ref. 14]. The goal of the MOPs is to display performance indicators to BLUEFOR units and not to provide one overall measure of how well the unit performed during its rotation. An overall MOE might lead people to rank and compare units and this is not the purpose of the NTC.

As previously stated, the primary purpose of the indicator reports is to initiate discussion during AARs. These reports can be maintained across the various battles to show improvements in performance or a degradation in unit performance. The key to making the reports a useful tool is determining the time periods from which useful data can be obtained. Periods of interest often will vary depending on the BOS from which an O/C wants a report. For the BOS Maneuver, critical periods may be direct fire engagements, obstacle breaches, and actions on the objective during a deliberate attack. For the BOS Intelligence, the critical period may be the 24 hours of intelligence gathering and analysis prior to being attacked by the OPFOR. The NTC typically allows rotating units to fight until they are almost completely destroyed. The data produced when 8 BLUEFOR vehicles are defending against 80 remaining OPFOR vehicles is essentially meaningless. O/Cs and TAF analysts need to exercise sound judgment in making the proper queries to the database to get meaningful results.

The next two sections of this chapter provide examples of indicator reports for the Battlefield Operating Systems (BOS) Intelligence and Maneuver which can be used to generate AAR discussion and track unit performance. The intent of these reports is not to compare one unit against another. It is critical to use the reports to generate discussion

and monitor the performance of individual units or staff sections. Indicator reports for the five other BOSs are in Appendix B.

1. Intelligence

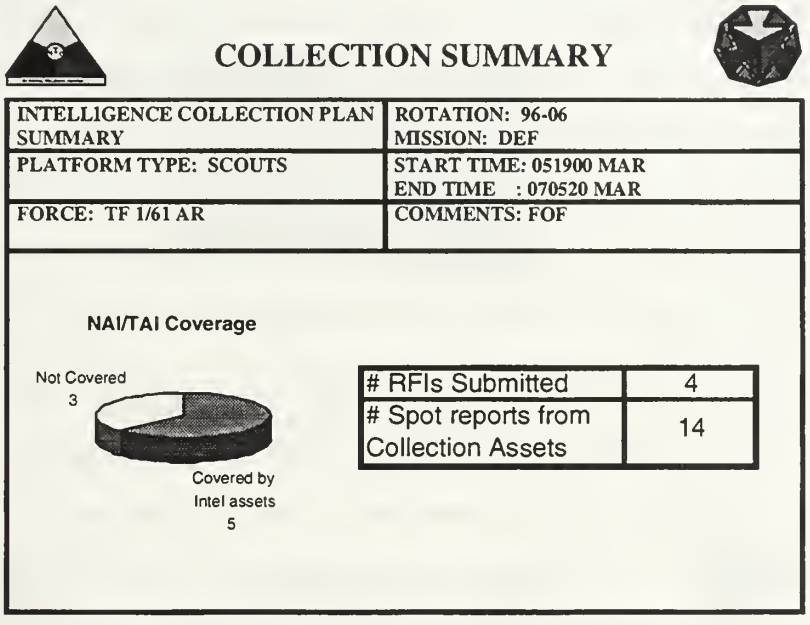


Figure 16. Intelligence.

Figure 16 displays data generated by making queries to the database. The information displayed in the figure comes from the Intelligence BOS card. The purpose of this report is to generate discussion on the collection of intelligence. The number of spot reports and percent of Named Areas of Interest (NAIs) and Targeted Areas of Interest (TAIs) covered are measures where high values are preferred to low ones. The number of Requests for Information (RFIs) is a relative number, but can still be beneficial during AAR discussion. If a unit had little information on enemy locations or intentions and only submitted two RFIs, then it did not make full use of all tools available to acquire the necessary information.

The O/Cs must use the charts to focus discussion on issues beyond the numbers. In the above example, the unit only covered 5 out of 8 NAIs and TAIs with intelligence assets. The critical discussion must examine the reasons why this occurred. Did the unit fail to plan assets properly, did allocated assets get destroyed enroute to observation post

(OP) locations, or were assets unavailable? Additional discussion can focus on redundant coverage of critical NAIs/TAIs as well as the unit's selection of NAIs/TAIs. These are just a few of areas that can be addressed from such a simple numeric measure of performance.

The MOP, number of spot reports, generates discussion in other areas. The O/Cs can ask leading questions prompting units to talk about the quality of spot reports as well as the principal sources of the spot reports. Did all the spot reports come from intelligence assets or did the platoons and companies generate some as well? Discussion can also lead into the S-2 (Intelligence) section's methods for recording, analyzing, and distributing to subordinates the information obtained from the spot reports.

The MOPs shown in Figure 16 can be used in conjunction with tools already in use at the NTC. When discussing intelligence, the O/Cs display computerized maps of the battlefield showing actual enemy locations and schematics of their intended courses of action versus the S-2's estimate of enemy positions and intentions. The S-2's NAI/TAI locations can be analyzed to determine if they assisted the S-2 in helping the commander "see the enemy" and can lead to discussion on how to improve for the next battle.

2. Maneuver

Figures 16 and 17 display data transmitted over the RDMS and Figure 18 displays data contained on the Company O/C evaluation card. They display three MOPs for the BOS Maneuver. Units desire a high force ratio during operations and a low rounds per kill. The number of dismounts who dismount the BFVs and actually get into the battle is a relative number and depends greatly upon the tactical situation in the individual companies. Benson addresses three additional maneuver MOPs: engagements by target type, engagement ranges by weapon system, and a BLUEFOR/OPFOR engagement comparison [Ref. 1].

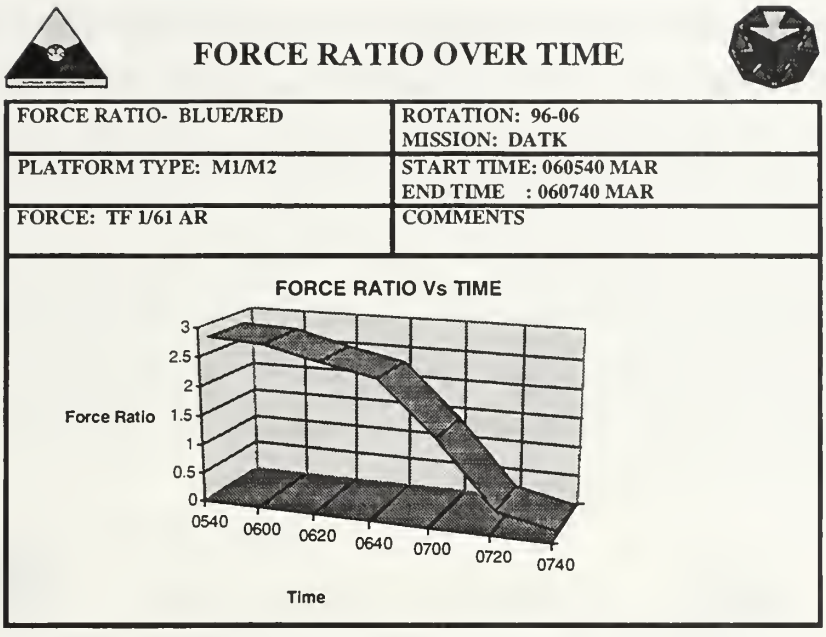


Figure 17. Force Ratio.

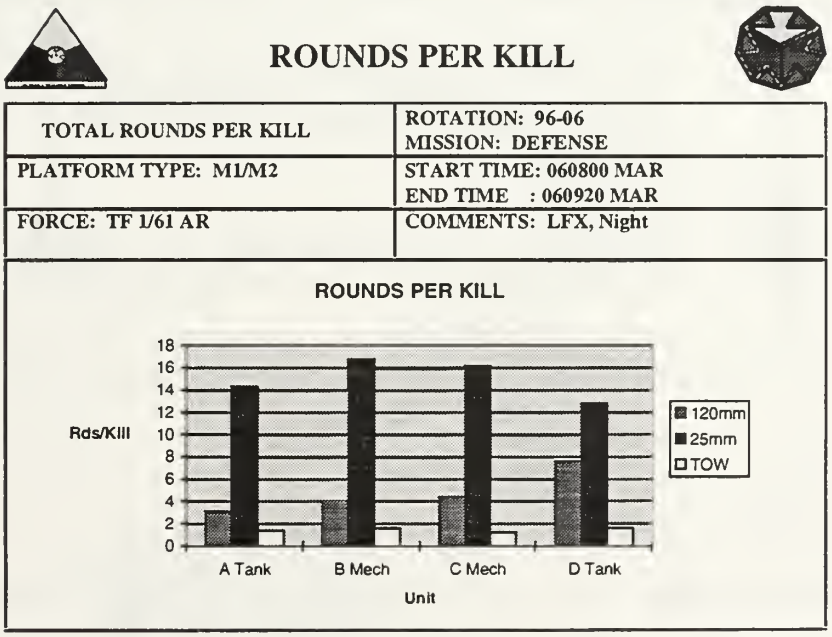


Figure 18. Rounds Per Kill.

These simple MOPs can again lead to valuable discussion. The force ratio MOP can be addressed by time periods centered around critical events. O/Cs can use sharp declines in the force ratio caused by chance engagements or indirect fires to initiate discussion about actions on contact or reactions to indirect fire. The rounds per kill

statistic is not shown to compare companies, but to generate discussion on gunnery techniques. In Figure 18, A Tank averaged 3.1 rounds per kill while D Tank averaged 7.6 rounds per kill. The key is for the O/C conducting the AAR to use these figures to ascertain the underlying causes of the different averages. Is it a function of boresighting techniques and ranges, individual crew gunnery skills, or is the underlying cause fire distribution and control? Soliciting healthy discussion from the company commanders will benefit the entire task force. Additionally, these MOPs can be tracked over various battles to show units how their gunnery performance varies over time, defensive versus offensive operations, and day versus night operations.

DISMOUNT UTILIZATION

USE OF DISMOUNTS BY COMPANY	ROTATION: 96-06 MISSION: MTC
PLATFORM TYPE: INFANTRY	START TIME: 060800 MAR END TIME : 060920 MAR
FORCE: TF 1/61 AR	COMMENTS

UNIT	DISMOUNTS		ENEMY KILLS	
	Available	Engaged	Personnel	Vehicle
A Tank	13	0	0	0
B Mech	22	12	17	3
D Mech	26	0	0	0
D Tank	9	9	0	2
Totals	70	21	17	5

Figure 19. Dismount Utilization

Figure 19 shows the number of dismounts out of those available who dismount the BFVs by company and their effects on enemy strength. A significant, yet often forgotten, element of combat power within a task force are the dismounted infantrymen carried in the back of the M2 BFVs. Typical mechanized units focus so much on gunnery and mechanized training that the use of dismounts is often overlooked, a tendency often exhibited at the NTC. The O/Cs can prompt company commanders to discuss the tactical considerations that led them to dismount their infantrymen or have them remain mounted.

Further prompting can lead to discussion on dismounted infantry planning considerations, rehearsals, and their effectiveness against enemy dismounted troops and combat vehicles.

The O/Cs are critical to making the MOPs useful tools. If they can show numeric figures and ask the right leading questions, the result will be open professional dialogue that will promote learning. An added benefit of these MOPs and a professional AAR is the education of BLUEFOR units in assessing their training at home station. The NTC O/Cs give the best AARs in the Army and they can use them as vehicles to teach units how to AAR themselves.

3. Additional Battle Analysis

The indicator reports are designed to be standard reports that can be produced as applicable for a particular AAR. The O/Cs can use additional information from the database to highlight the factors that influenced a certain measure of performance. This information can be used to support or reject the BLUEFOR's analysis of a training deficiency. For example, when preparing for an AAR, an O/C observes the Attrition to Red A/C report shown in Figure 20.

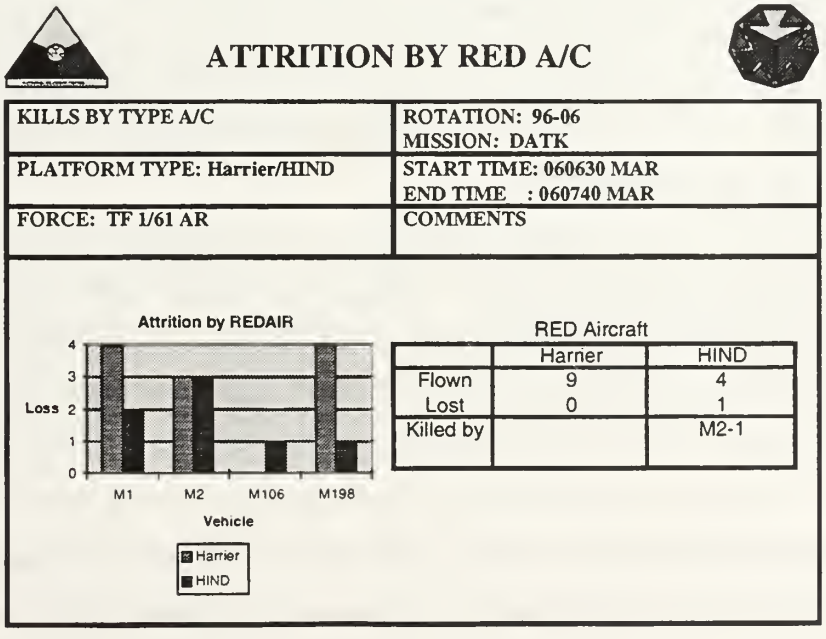


Figure 20. Attrition by OPFOR Aircraft.

This chart shows that OPFOR aircraft killed an extensive number of BLUEFOR systems and experienced only one HIND helicopter lost to a M2 BFV. The conclusion to be drawn from this chart is that the BLUEFOR did a poor job in defending against enemy air attack. To gain additional information, the O/C has his TAF analyst query the database to obtain relevant information from the Air Defense, Platoon, and Company O/C cards. The results of the query are displayed in Figure 21.

Air Defense	**Evaluation**
Employ Air Defense guns and missiles	3
Air avenues of approach identified and disseminated	1
Early Warning	1
Platoon	
Air guard SOP and execution	3.56
Company	
Employment of organic weapons against enemy air	4.23

Figure 21. Query.

During the course of the AAR, the chart in Figure 20 is shown to solicit comments on the BOS Air Defense. The battalion air defense officer proposes that the small number of aircraft shot down can be attributed to the small volumes of fire provided by the maneuver companies because they were involved in direct fire engagements against enemy ground forces. All four company commanders contest that line of reasoning, claiming that their men were engaging aircraft.

O/Cs can then show the chart in Figure 21. This chart refutes the air defense officer's assessment of the poor performance and supports the company commanders' claims that their systems were shooting. The major causes behind the lack of air defense protection appear to be poor early warning and a poor analysis of enemy air avenues of approach. The O/Cs must get the unit to offer discussion in these areas so that they understand their shortcomings. Given the data in Figure 21, the O/Cs may also want to inquire why the adequately deployed air defense systems failed to shoot down a single aircraft.

C. POST-ROTATION ANALYSIS

Not all relevant training issues get discussed during the conduct of an AAR. The two-hour time limit on the AAR limits the discussion to only the most critical training issues. Many problem areas remain unresolved when units return to home station. The 14 days of training against the OPFOR occur at a pace that keeps the BLUEFOR and the O/Cs extremely busy. The BLUEFOR is continually planning or preparing to fight the next battle while the O/Cs are observing training or preparing and conducting AARs. There is little time for the BLUEFOR to reflect on what has occurred. The only way smaller training issues are surfaced is by the O/Cs discussing them with the unit in an informal forum outside of the AAR or if they include them in the THP.

However, current THPs are only as good as the O/C's memory and the amount of effort he puts into them. Historically, they are not used very extensively at home station. Current efforts by NPS students Olenginski and Seise attempt to remedy this shortcoming. They are developing a CD-ROM based THP that will incorporate the proposed database of both RDMS and subjective O/C data. The THP will allow analysis of every battle a unit fights by Battlefield Operating System (BOS) and will contain selected audio and video data. The purpose of having the data embedded in the CD-ROM is to allow the BLUEFOR units the opportunity to conduct their own detailed analysis at home station without any time constraints.

Current post-rotation analysis is conducted at the Center for Army Lessons Learned (CALL) at Fort Leavenworth, Kansas. CALL analysts receive video tapes of all AARs, operational graphics, analog tapes of the current database, and an executive summary version of the THP. They are responsible for the storage of these materials for archival purposes.

Extracting data from the current database is very complicated and often yields marginal results. Additionally, O/C observations are included only in the form of narrative comments, thus analysts are forced to assign some form of measurement scale to the descriptive words of the O/C without any supporting data. The proposed database and

CD-ROM THP will support simple data retrieval, include O/C subjective evaluations, and support digital audio and video data.

Post-rotation analysis is beneficial for two reasons: 1) it identifies the training deficiencies of the rotating unit and 2) it assists in the development of current training trends. These two forms of analysis are distinctly different. One type attempts to identify the training shortcomings of one unit during one rotation so that the unit can develop a training plan to correct them, while the other attempts to identify systematic shortcomings for all units across all rotations.

1. Army Trends

The NTC maintains a list of the top ten training trends that it desires to reverse. These trends are currently based on O/C observations without any form of O/C subjective data to support them. The areas of performance in need of improvement are shown in Figure 22.

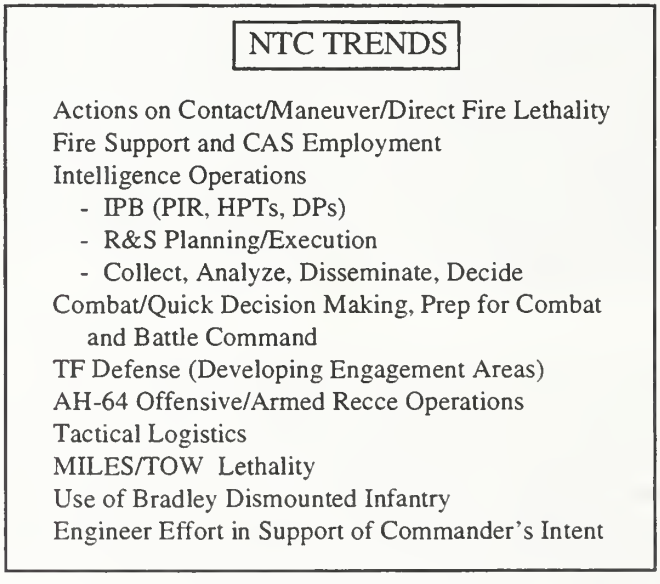


Figure 22. NTC Trends.

The trends listed in Figure 22 are loosely defined and cover broad areas of performance. The NTC has assigned responsible O/C teams to develop methodologies to reverse these trends. A shortage of reliable data has hampered attempts by the NTC to monitor and reverse noted trends. Critical to reversing trends is identification of the root

causes behind substandard performance. The evaluation cards proposed in this research can serve as a tool to assist O/Cs in this task. Additionally, O/Cs can use the task of interest blocks on the cards to further help them in root cause analysis.

One of the trends listed in Figure 22 is intelligence operations. O/Cs can use the Intelligence BOS card to determine the underlying causes of the poor performance in intelligence operations. If the card does not provide the necessary information to accomplish this, the senior O/C responsible for reversing this trend should add as many tasks of interest as he feels necessary to collect the needed data. This technique is analogous to the focused rotation (FR) concept that has been used by the RAND Corporation and other analytic agencies when conducting studies at the NTC. RAND has discovered that it takes at least 12 rotations worth of data to allow for meaningful analysis [Ref. 14].

Tracking of Commander's Priority Requirements (PIR) Triggers to shift recon focus based on enemy situation Tracking of R&S assets

Figure 23. Tasks of Interest.

In order to determine the root causes of poor performance in intelligence operations, the O/C responsible for evaluating intelligence adds the tasks of interest shown in Figure 23 to the Intelligence BOS card. These data, along with data collection items currently on the Intelligence BOS card, could be maintained over several rotations to see what trends, if any, exist. The subjective evaluations of the three tasks of interest along with the "collect information" and "process information" sections of the Intelligence BOS card are in Table 8.

Rotation	A	B	C	D	E	F	G	H	I	J	K	L	Mean	s
Collect Information														
Information collected as result of R&S plan	3	2	3	4	3	1	3	5	3	3	4	3	3.08	0.99
Continuous collection from all sources	2	1	2	3	1	2	3	3	2	1	2	3	2.08	0.79
Process Information														
Evaluate threat information	2	1	1	2	2	3	3	1	2	2	1	1	1.75	0.75
Evaluate physical environment	4	3	2	3	3	3	3	3	4	4	3	3	3.17	0.58
Integrate intelligence information	1	0	3	4	2	5	1	5	2	1	1	3	2.33	1.67
Develop enemy intentions	1	1	2	1	1	3	1	2	1	1	3	4	1.75	1.05
Develop targeting information	3	2	5	4	3	2	1	5	3	4	2	4	3.17	1.26
Prepare intelligence reports	4	3	4	4	4	3	2	1	2	2	3	3	2.91	0.99
Update situational template	N/O	2	1	N/O	0	0	N/O	2	0	2	0	1	0.89	0.92
Provide battlefield reports	5	1	2	3	1	3	2	4	1	3	3	4	2.67	1.3
Tasks of Interest														
Tracking commander's PIR	2	1	5	N/O	2	N/O	0	4	2	1	4	0	2.1	1.72
Triggers to shift recon focus	0	1	0	2	0	2	2	2	0	0	1	0	0.83	0.93
Tracking R&S assets	3	4	3	3	3	3	3	3	3	2	3	5	3.16	0.72

Table 8. Intelligence Data.

Table 8 displays the O/C subjective data collected from twelve hypothetical live-fire deliberate attack missions. The last two columns show the sample mean $\left(\bar{x}\right)$ and sample standard deviation (s) for each area of performance. These two simple statistics make identifying performance trends an easy task.

The mean provides the arithmetic average of the subjective O/C ratings per task across the twelve rotations. This gives the O/C a general idea how well units are performing each task over numerous rotations. Values over 2.5 indicate that units are performing the task in an adequate manner; values below 2.5 indicate less than adequate performance. However, the more beneficial of the two statistics is the sample standard deviation. The standard deviation measures dispersion about the mean. A large standard deviation indicates that the units vary widely in their performance of the task.

Small standard deviations are key to identifying trends in unit performance. From Table 8, two evaluated tasks show identical means. Both tasks, "evaluate physical environment" and "develop targeting information", had a mean of 3.17 over the twelve rotations. The large difference in the standard deviations of these two tasks provide two different interpretations of the data. The standard deviation for the task "develop targeting information" is more than twice that of the task "evaluate physical environment", meaning that performance on the former task varied widely between the units. The task "evaluate physical environment" had a standard deviation of 0.58 which indicates that

every unit performed at a level near the mean. In this case, the mean of 3.17 indicates a trend of adequate performance in that task.

Critical to O/Cs and analysts are the tasks that have a low mean and a low standard deviation. From Table 8, the task "update situational template" shows a mean of 0.89 and a standard deviation of 0.92. These statistics indicate a trend of poor performance with only a small amount of variation between units. If these were actual historical data, these data would lead one to conclude that the task "update situational template" is a contributing factor to the stated NTC trend of poor performance in the area of intelligence operations.

2. Trend Reversal

It is important for the O/Cs and analysts to note, however, that this type of analysis only identifies the contributing factors to poor performance. In no way does it provide methods to reverse trends. Reversing a trend is a distinct and separate issue. The performance of a unit at NTC is a function of many variables. Personnel turnover, the amount of training time available at home station, experience level of leadership, unit motivation, and the tactics, techniques, and procedures (TTPs) employed by that unit are just a few of the variables that can affect a unit's performance. All of these variables have the potential to be contributing factors to poor performance. The NTC can only impact a few of these variables; it should not be looked upon as a panacea to correct all training shortcomings within a unit.

The NTC has no control over personnel turbulence, the training time allotted to a unit at home station, or its motivation and *esprit de corps.* The greatest benefits that BLUEFOR units derive from their NTC rotations are a thorough training assessment and a professional discussion of TTPs. The vast majority of units have a solid understanding of Army doctrine taught in the service schools and written in numerous manuals. These sources discuss combat operations in terms of basic principles and tenets such as mass, surprise, agility, and versatility [Ref. 15], but they often refrain from providing the implementing techniques necessary to insure these principles are met.

Tactics, techniques, and procedures (TTPs) are what units employ to satisfy the principles of successful combat operations. Although recent field manuals have documented some TTPs in rudimentary fashion, TTPs are in a constant state of change because of equipment and force structure changes. The O/Cs at the NTC get to observe the TTPs employed by all BLUEFOR units and thus are able to recommend TTPs that have been proven effective over time. Documenting these TTPs with the Center for Army Lessons Learned (CALL) and the numerous professional periodicals in existence will help disseminate useful TTPs Army-wide. These recommended TTPs could also be included in the CD-ROM THP that will be given to all units upon completion of their rotation.

Additionally, the NTC should maintain a composite historical database to assist in trend analysis. This database should be tailored so that it only contains relevant data in order to minimize storage requirements. Only the RDMS data from the actual battles and subjective O/C evaluations should be stored. This will allow O/Cs and analysts to be able to analyze trends over long periods of time to determine whether or not there have been any training improvements. There are a number of statistical techniques, the method of moving averages for example, that can be employed to track long term historical trends.

3. BLUEFOR Analysis

Upon completion of a rotation at the NTC, O/Cs conduct final AARs on each unit. BLUEFOR units typically receive their written THP at this time. In this final AAR, O/Cs discuss the overall strengths and areas in need of improvement for each unit. Much of the discussion focuses on developing a training plan that the unit can implement at home station to correct noted training deficiencies. However, the full implications and benefits of a unit's rotation at the NTC are not yet fully known at this point. Units are mentally and physically exhausted after 14 days in the desert and are also focused on the enormous tasks of turning in all their equipment to NTC motor pools and redeploying to home station. The overall lessons learned from the rotation will not be realized until well after the rotation when the unit can reflect upon its performance.

Imbedding the data from a rotation in the CD-ROM THP will provide new opportunities for BLUEFOR units to conduct detailed analysis of their rotation at home station. A battalion commander will now have access to numerical evaluations of performance instead of narrative comments stating that the unit should "sustain" its performance on task A and that performance on task B "needs improvement." Battalion commanders know their units much better than the O/Cs at NTC. They know which of their units have high personnel turbulence, inexperienced leaders, or have had a lack of quality field training opportunities. This knowledge will allow them to draw more meaningful conclusions from the data.

The purpose for conducting detailed home station analysis is to finalize the development of a training plan to address noted training deficiencies. The CD-ROM THP currently under development will incorporate pick lists, making it easy for leaders at home station to examine the data in a variety of ways. Potential analyses include, but are not limited to, a cross-unit analysis, an echelon analysis, or a time analysis of a particular BOS or unit. The unit knowledge of the leader conducting the analysis will allow him to focus on only the most relevant O/C observations.

Platoon	A	B	C	D	E	F	G	H	I	J	K	L	Mean	s
Prep for Combat														
Boresight	3	3	2	2	3	3	4	1	3	4	3	2	2.75	0.87
PCI	2	4	3	3	5	1	0	4	1	5	3	4	2.92	1.62
Class III/V upload	4	4	3	4	3	4	3	4	3	4	3	2	3.42	0.69
Rehearsals	3	2	3	5	4	1	3	5	1	3	2	3	2.92	1.31
Safety/risk	0	0	4	3	2	3	0	1	3	0	0	2	1.5	1.51
Warning Order	0	3	1	2	0	3	2	N/O	3	1	0	1	1.45	1.21
Operations Order	2	2	1	2	3	1	2	2	1	1	1	2	1.67	0.65
Mean	2	2.57	2.42	3	2.85	2.28	2	2.83	2.14	2.57	1.71	2.28		
Standard Dev.	1.53	1.39	1.13	1.15	1.57	1.25	1.52	1.72	1.06	1.9	1.38	0.95		

Table 9. Cross-unit Analysis (Prep for Combat).

Table 9 displays the subjective O/C evaluations of a battalion's 12 platoons on preparation for combat tasks. This table shows data from one battle. A composite table could show the averages for each platoon across all battles conducted during the rotation. What is immediately apparent from the table are the low means for the last three tasks in the table. These are leader tasks and the evaluations indicate that performance was substandard. The battalion commander's knowledge about the amount of experience his

platoon leaders have preparing orders and the time constraints they were placed under at NTC will enable him to make an assessment beyond the numbers.

Table 10 shows the rounds per kill statistics for each platoon and company as well as the overall task force statistics for the two daytime live-fire missions. These data, separated by echelon, show the effectiveness of gunners during defensive versus offensive operations. This same type of side-by-side comparison could be done for day versus night operations. To gain additional information about gunnery skills, the battalion commander could examine engagement range data, fire control and distribution observations, and boresight data. Leaders can use these data to determine if a high rounds per kill is a gunnery problem alone, or if the battalion also needs to improve in fire control and distribution or boresighting.

ROUNDS PER KILL				
	Defense		Offense	
	M1	M2	M1	M2
A Tank	2.2	14.8	4.3	27.3
1st Plt	2.7		6.1	
2nd Plt	1.6		3.8	
3rd Plt		14.8		27.3
B Mech	2.6	21.3	4.8	21.8
1st Plt		19.5		22.7
2nd Plt		22		21.4
3rd Plt	2.6		4.8	
D Mech	1.3	17.6	6.1	22.7
1st Plt	1.3		6.1	
2nd Plt		21.4		23.3
3rd Plt		15.8		21.6
D Tank	2.7	15.6	2.6	17.6
1st Plt	3.1		2.8	
2nd Plt		15.6		17.6
3rd Plt	1.9		2.1	
TF Totals	2.4	17.9	4.1	24.2

Table 10. Echelon Analysis (Rounds per kill).

BOS- Intelligence	FOF			Live Fire		FOF	
	MTC	DEF	DATK	DATK	DEF	MTC	DATK
Process Information							
Evaluate threat information	1	2	2	2	2	3	3
Evaluate physical environment	2	2	4	4	2	3	5
Integrate intelligence information	1	1	2	2	2	3	2
Develop enemy intentions	1	3	2	3	5	1	3
Develop targeting information	0	1	1	2	2	2	2
Prepare intelligence reports	3	2	3	3	4	3	3
Update situational template	1	2	2	1	2	1	1
Provide battlefield reports	2	2	2	2	3	3	3

Table 11. Time Analysis (Process Information).

Table 11 displays subjective O/C evaluations for the "process information" section of the Intelligence BOS card across all battles of a battalion's rotation. The battalion commander or S-2 could use this information to identify the specific areas or particular types of battles where performance was less than adequate. It is not always necessary to calculate means and standard deviations to draw conclusions from the data. A cursory inspection of Table 11 shows that performance of the tasks "update situational template" and "develop targeting information" were poor throughout the rotation, while performance on the task "prepare intelligence reports" was continually solid. Additionally, the S-2 section did a good job evaluating the physical environment for deliberate attacks, but did a poor job developing enemy intentions for movements to contact.

The pick lists on the CD-ROM THP will support a variety of analyses and not all analysis should be driven by numbers and statistics. The CD-ROM THP will contain numerous computerized pictures of the critical phases in each instrumented battle. These pictures are beneficial because they display the actual locations and strengths of both BLUEFOR and OPFOR units. A battalion commander could examine various pictures of a breaching operation by time period to analyze the effectiveness of fires from the support force, the effectiveness of indirect fires, and the number of BLUEFOR vehicles destroyed during the actual breach. Other pictures can be used to examine how particular battlefield operating systems (BOS) were integrated in the battle. The S-2's estimate of enemy locations in the vicinity of the breach can be superimposed on actual enemy locations.

This can provide insight into the sufficiency of NAI/TAI locations and the task force reconnaissance effort.

Thorough home station analysis is critical to developing a sound training plan. Leaders at home station have a better feel for what training opportunities and resources actually exist. A detailed analysis with applied leader knowledge will allow leaders to develop training priorities and determine the level of training that needs to be executed in order to correct training deficiencies. In some situations, the answer will be professional development classes. In others, the answer might be combat simulations, staff exercises, or field exercises. The value of this analysis is the commander's ability to determine the appropriate training tool to correct the deficiency in the least amount of time using the fewest resources. The introduction of the CD-ROM THP will significantly increase the amount, speed, and quality of home station analysis.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This research proposed several methodologies for the NTC. The first methodology specified the tasks that should be subjectively evaluated by O/Cs. These tasks, organized by BOS, represent a refined list that is based upon tasks currently evaluated at the NTC and tasks listed in U. S. Army training manuals.

A second methodology developed a subjective training measurement scale that is a minor modification of standard graphic rating scales. Behaviorally anchored words and added standards for each evaluation assist in making this a scale that exhibits equal interval properties. In addition to the scale are other evaluation categories that were designed to remove ambiguity and account for all possible evaluation scenarios. With assistance from TAF analysts, it is now possible to make numerous judgments on tasks that are executed repeatedly during the course of a battle.

This research also proposed the addition of two semantic objects to the database developed by Benson to facilitate the implementation of subjective data into the database [Ref. 1]. An example graphical user interface (GUI) was included to demonstrate the simplistic system that TAF analysts will need to input subjective data into the database. A similar GUI will allow TAF analysts to query the database to produce specialized reports for AARs.

A fourth methodology developed quantifiable measures of performance (MOPs) for each BOS to be used as indicators of performance. The implementation of these MOPs is in the form of reports that are designed to generate AAR discussion. Also included in this research was a discussion on how to query the database for additional information in order to conduct a rudimentary root cause analysis of a training deficiency indicated by a MOP.

Finally, this research proposed a methodology for conducting post rotation analysis using basic statistics. The focus of this analysis was twofold. First, O/Cs and analysts could conduct analysis to identify training deficiencies across all units over all rotations. The purpose of this analysis was to identify the root causes of negative trends. Methods were introduced to reverse trends through the quantifiable identification of the root causes of the trend, a recommendation to include successful TTPs in the CD-ROM based THP , and tracking techniques to monitor performance on tasks listed as negative trends.

A discussion of unit post rotational analysis provided a methodology for units at home station to query data from the CD-ROM THP to conduct further analysis. Methods included the use of unit based knowledge, statistics, and the other graphical measures provided in the THP. The purpose of this analysis differs from the O/Cs' analysis in that it focuses on only one unit and its purpose is to assist in training plan development.

The greatest strength of all these methodologies is that they are simple. They involve the examination of training by BOS and by unit echelon, techniques already in use at the NTC. Additionally, when mathematics are introduced, only simple, commonly understood statistics are recommended for root cause analysis and trend identification. Graphical user interfaces are recommended to enable every analyst to have the ability to input data into the database as well as query the database for information to produce specific reports.

B. RECOMMENDATIONS

Future research should focus on three distinct areas. The methodologies presented in this research are all oriented on the maneuver task force. Future studies should focus on the combat units not examined (attack aviation and field artillery units) as well as combat support and combat service support units. Not only should consideration for these units alone be given, but how they interact together within a maneuver brigade.

NTC currently has plans to replace microwave transmissions with a fiber optic communications network. The leadership at NTC also desires to have fully automated platoon and company AARs in the future. With network access available inside the maneuver training areas, consideration should be given to allowing the O/Cs to input their own data with the assistance of small, lightweight computers. This network will also allow the O/C to retrieve data from the database for the conduct of automated AARs. Future research could focus on developing a methodology of implementing such a data intensive event just two hours after the conclusion of a battle.

Finally, the effectiveness of the proposed measurement system and MOPs should be examined. The MOPs should be evaluated to examine if they are providing the necessary information to generate quality AAR discussion. The measurement system should be inspected to check if it meets normally accepted standards in the areas of reliability, accuracy, and validity.

APPENDIX A. BOS EVALUATION CARDS

1. Intelligence

Mission DATK MTC DEF LF FOF
TF_____ TD_____

	Conduct Intelligence Planning	Observation
87	Integrated Threat Templates	0 1 2 3 4 5 N/A N/O
88	Doctrinal	0 1 2 3 4 5 N/A N/O
89	Event	0 1 2 3 4 5 N/A N/O
90	Situational	0 1 2 3 4 5 N/A N/O
91	Input to DST	0 1 2 3 4 5 N/A N/O
92	Terrain and Weather Analysis	0 1 2 3 4 5 N/A N/O
	Collect Information	
93	Spot report received as a result of R&S plan	0 1 2 3 4 5 N/A N/O
94	Continuous information collection and acquisition from all sources	0 1 2 3 4 5 N/A N/O
95	# NIA,TIA/Covered by scouts or IEW	____/____
96	RFI submission	0 1 2 3 4 5 N/A N/O
	Process Information	
97	Evaluate threat information	0 1 2 3 4 5 N/A N/O
98	Evaluate physical environment	0 1 2 3 4 5 N/A N/O
99	Integrate intelligence information	0 1 2 3 4 5 N/A N/O
100	Develop enemy intentions	0 1 2 3 4 5 N/A N/O
101	Develop targeting information	0 1 2 3 4 5 N/A N/O
102	Prepare intelligence reports	0 1 2 3 4 5 N/A N/O
103	Update situational template	0 1 2 3 4 5 N/A N/O
104	Provide battlefield area reports	0 1 2 3 4 5 N/A N/O
	Disseminate Intelligence	
105	Sending processed intelligence to maneuver teams	0 1 2 3 4 5 N/A N/O
106	Sending of raw intelligence directly from R&S elements to cdr should it be time sensitive	0 1 2 3 4 5 N/A N/O
107	Dissemination of battlefield reports	0 1 2 3 4 5 N/A N/O
108	Task of Interest 1	0 1 2 3 4 5 N/A N/O
109	Task of Interest 2	0 1 2 3 4 5 N/A N/O
110	Task of Interest 3	0 1 2 3 4 5 N/A N/O
111	Freeform 1	
112	Freeform 2	

2. Maneuver

Mission DATK MTC DEF LF FOF
TF_____ TD_____

	Conduct Tactical Movement	Observation
113	Movement, mounted and dismounted; on road and cross country	0 1 2 3 4 5 N/A N/O
114	Closure of movement- tactical assembly area tactical positions	0 1 2 3 4 5 N/A N/O
115	Navigation	0 1 2 3 4 5 N/A N/O
116	Force Protection	0 1 2 3 4 5 N/A N/O
117	Air movement	0 1 2 3 4 5 N/A N/O
	Engage Enemy with Direct Fire and Maneuver	
118	Preparation of engagement areas	0 1 2 3 4 5 N/A N/O
119	Rehearsals of battle plans	0 1 2 3 4 5 N/A N/O
120	Fire control and distribution	0 1 2 3 4 5 N/A N/O
121	Integration of direct fire with maneuver	0 1 2 3 4 5 N/A N/O
122	Control of terrain	0 1 2 3 4 5 N/A N/O
123	Consolidation and Reorganization	0 1 2 3 4 5 N/A N/O
124	Task of Interest 1	0 1 2 3 4 5 N/A N/O
125	Task of Interest 2	0 1 2 3 4 5 N/A N/O
126	Task of Interest 3	0 1 2 3 4 5 N/A N/O
127	Freeform 1	
128	Freeform 2	

3. Fire Support

Mission DATK MTC DEF LF FOF
TF_____ TD_____

		Observation
	Employ Mortars	
129	Prepare to fire checks	0 1 2 3 4 5 N/A N/O
130	Development of order to fire	0 1 2 3 4 5 N/A N/O
131	Tactical movement	0 1 2 3 4 5 N/A N/O
132	FDC operations	0 1 2 3 4 5 N/A N/O
133	Target engagements	0 1 2 3 4 5 N/A N/O
134	Fire Mission #Rounds/Ineffective, Suppressive, or Effective	____/____
	Employ Field Artillery	
135	Fire Support-Maneuver rehearsals	0 1 2 3 4 5 N/A N/O
136	FSE operations	0 1 2 3 4 5 N/A N/O
137	Preparation	0 1 2 3 4 5 N/A N/O
138	Execution	0 1 2 3 4 5 N/A N/O
139	FSO and FIST operations in coordination with their maneuver commander	0 1 2 3 4 5 N/A N/O
140	Indirect fires in support of maneuver cdr's intent	0 1 2 3 4 5 N/A N/O
141	Indirect fire planning as battlefield METT-T change	0 1 2 3 4 5 N/A N/O
142	Fire Mission #Rounds/Ineffective, Suppressive, or Effective	____/____
	Employ Close Air Support	
143	Air-ground attack requests	0 1 2 3 4 5 N/A N/O
144	Airspace coordination and management	0 1 2 3 4 5 N/A N/O
	Coordinate, Synchronize, and Integrate FS	
145	Coordination of all fire support means in support of maneuver cdr's concept and intent	0 1 2 3 4 5 N/A N/O
146	Preparation and execution tasks undertaken to integrate the fire support plan detailed in OPORD	0 1 2 3 4 5 N/A N/O
147	Task of Interest 1	0 1 2 3 4 5 N/A N/O
148	Task of Interest 2	0 1 2 3 4 5 N/A N/O
149	Task of Interest 3	0 1 2 3 4 5 N/A N/O
150	Freeform 1	
151	Freeform 2	

4. Air Defense

Mission DATK MTC DEF LF FOF
TF_____ TD_____

	Take Active Air Defense Measures	Observation
152	Employ Air Defense Artillery guns and missiles	0 1 2 3 4 5 N/A N/O
153	Airspace management	0 1 2 3 4 5 N/A N/O
154	Early warning	0 1 2 3 4 5 N/A N/O
155	# Enemy a/c flown / # destroyed	____/____
	Take Passive Air Defense Measures	
156	Air avenues of approach identified and disseminated	0 1 2 3 4 5 N/A N/O
157	Dispersion	0 1 2 3 4 5 N/A N/O
158	Cover and concealment	0 1 2 3 4 5 N/A N/O
159	Deception	0 1 2 3 4 5 N/A N/O
160	Task of Interest 1	0 1 2 3 4 5 N/A N/O
161	Task of Interest 2	0 1 2 3 4 5 N/A N/O
162	Task of Interest 3	0 1 2 3 4 5 N/A N/O
163	Freeform 1	
164	Freeform 2	

5. Mobility/Countermobility/Survivability

Mission DATK MTC DEF LF FOF
TF_____ TD_____

		Observation
	Overcome Obstacles	
165	Breach a defended obstacle	0 1 2 3 4 5 N/A N/O
166	Cross gaps	0 1 2 3 4 5 N/A N/O
	Provide Countermobility	
167	Emplacement of mines and complex obstacles	0 1 2 3 4 5 N/A N/O
168	Digging tank ditches	0 1 2 3 4 5 N/A N/O
169	Creation of road craters with explosives	0 1 2 3 4 5 N/A N/O
170	Terrain enhancement	0 1 2 3 4 5 N/A N/O
171	Employ scatterable mines	0 1 2 3 4 5 N/A N/O
172	# Mines employed / # mines available	____/____
	Enhance Physical Protection	
173	Construction of fighting positions	0 1 2 3 4 5 N/A N/O
174	Preparation of protective positions	0 1 2 3 4 5 N/A N/O
175	Employment of protective equipment	0 1 2 3 4 5 N/A N/O
	Provide Operations Security	
176	Analysis to determine key assets and threats to them	0 1 2 3 4 5 N/A N/O
177	Cover and concealment	0 1 2 3 4 5 N/A N/O
178	Camouflage	0 1 2 3 4 5 N/A N/O
179	Noise and light discipline	0 1 2 3 4 5 N/A N/O
180	Counter reconnaissance	0 1 2 3 4 5 N/A N/O
181	Physical Security measures	0 1 2 3 4 5 N/A N/O
182	Signal security	0 1 2 3 4 5 N/A N/O
183	Electronic security	0 1 2 3 4 5 N/A N/O
	Provide Decontamination	
184	Decontamination of weapon systems and supplies	0 1 2 3 4 5 N/A N/O
185	Hasty and Deliberate decon	0 1 2 3 4 5 N/A N/O
186	Proper and timely NBC reports sent	0 1 2 3 4 5 N/A N/O
187	Task of Interest 1	0 1 2 3 4 5 N/A N/O
188	Task of Interest 2	0 1 2 3 4 5 N/A N/O
189	Task of Interest 3	0 1 2 3 4 5 N/A N/O

190 Freeform 1 _____

191 Freeform 2 _____

6. Combat Service Support

Mission DATK MTC DEF LF FOF
TF_____ TD_____

		Observation
	Conduct Supply Operations	
192	Requesting, receiving, storing, protecting, and issuing supplies to specific elements	0 1 2 3 4 5 N/A N/O
193	Providing munitions to weapon systems	0 1 2 3 4 5 N/A N/O
194	Providing fuel and petroleum products	0 1 2 3 4 5 N/A N/O
195	Reporting status	0 1 2 3 4 5 N/A N/O
	Provide Personnel Services	
196	Replacement, casualty reporting	0 1 2 3 4 5 N/A N/O
197	Awards and decorations	0 1 2 3 4 5 N/A N/O
198	Postal operations	0 1 2 3 4 5 N/A N/O
199	Promotions, reductions	0 1 2 3 4 5 N/A N/O
200	Financial services	0 1 2 3 4 5 N/A N/O
201	Unit Ministry team	0 1 2 3 4 5 N/A N/O
202	Legal	0 1 2 3 4 5 N/A N/O
203	Reporting of personnel status	0 1 2 3 4 5 N/A N/O
204	Preservation of force through safety	0 1 2 3 4 5 N/A N/O
	Maintain Weapons and Equipment	
205	Preventive maintenance	0 1 2 3 4 5 N/A N/O
206	Recovery	0 1 2 3 4 5 N/A N/O
207	Diagnosis, substitution, exchange, repair and return of weapons and equipment	0 1 2 3 4 5 N/A N/O
208	Reporting status	0 1 2 3 4 5 N/A N/O
	Provide Health Services	
209	Preventive medicine	0 1 2 3 4 5 N/A N/O
210	Field sanitation	0 1 2 3 4 5 N/A N/O
	Treat and Evacuate Battlefield Casualties	
211	Triage of battlefield casualties	0 1 2 3 4 5 N/A N/O
212	Treatment and Movement of casualties to rear	0 1 2 3 4 5 N/A N/O
213	Identification of levels of care and locations	0 1 2 3 4 5 N/A N/O
214	Coordination of movement of aid stations to ensure continuity of care	0 1 2 3 4 5 N/A N/O
215	Rehearsals	0 1 2 3 4 5 N/A N/O
216	Resupply	0 1 2 3 4 5 N/A N/O
217	Evacuation	0 1 2 3 4 5 N/A N/O
218	Ground ambulance and air-medevac	0 1 2 3 4 5 N/A N/O
219	Handling and processing remains of soldiers who have died of wounds	0 1 2 3 4 5 N/A N/O
220	Reporting status	0 1 2 3 4 5 N/A N/O
221	Task of Interest 1	0 1 2 3 4 5 N/A N/O
222	Task of Interest 2	0 1 2 3 4 5 N/A N/O
223	Task of Interest 3	0 1 2 3 4 5 N/A N/O

224 Freeform 1 _____

225 Freeform 2 _____

7. Battle Command

Mission DATK MTC DEF LF FOF
TF_____ TD_____

		Observation
	Conduct Supply Operations	
192	Requesting, receiving, storing, protecting, and issuing supplies to specific elements	0 1 2 3 4 5 N/A N/O
193	Providing munitions to weapon systems	0 1 2 3 4 5 N/A N/O
194	Providing fuel and petroleum products	0 1 2 3 4 5 N/A N/O
195	Reporting status	0 1 2 3 4 5 N/A N/O
	Provide Personnel Services	
196	Replacement, casualty reporting	0 1 2 3 4 5 N/A N/O
197	Awards and decorations	0 1 2 3 4 5 N/A N/O
198	Postal operations	0 1 2 3 4 5 N/A N/O
199	Promotions, reductions	0 1 2 3 4 5 N/A N/O
200	Financial services	0 1 2 3 4 5 N/A N/O
201	Unit Ministry team	0 1 2 3 4 5 N/A N/O
202	Legal	0 1 2 3 4 5 N/A N/O
203	Reporting of personnel status	0 1 2 3 4 5 N/A N/O
204	Preservation of force through safety	0 1 2 3 4 5 N/A N/O
	Maintain Weapons and Equipment	
205	Preventive maintenance	0 1 2 3 4 5 N/A N/O
206	Recovery	0 1 2 3 4 5 N/A N/O
207	Diagnosis, substitution, exchange, repair and return of weapons and equipment	0 1 2 3 4 5 N/A N/O
208	Reporting status	0 1 2 3 4 5 N/A N/O
	Provide Health Services	
209	Preventive medicine	0 1 2 3 4 5 N/A N/O
210	Field sanitation	0 1 2 3 4 5 N/A N/O
	Treat and Evacuate Battlefield Casualties	
211	Triage of battlefield casualties	0 1 2 3 4 5 N/A N/O
212	Treatment and Movement of casualties to rear	0 1 2 3 4 5 N/A N/O
213	Identification of levels of care and locations	0 1 2 3 4 5 N/A N/O
214	Coordination of movement of aid stations to ensure continuity of care	0 1 2 3 4 5 N/A N/O
215	Rehearsals	0 1 2 3 4 5 N/A N/O
216	Resupply	0 1 2 3 4 5 N/A N/O
217	Evacuation	0 1 2 3 4 5 N/A N/O
218	Ground ambulance and air-medevac	0 1 2 3 4 5 N/A N/O
219	Handling and processing remains of soldiers who have died of wounds	0 1 2 3 4 5 N/A N/O
220	Reporting status	0 1 2 3 4 5 N/A N/O
221	Task of Interest 1	0 1 2 3 4 5 N/A N/O
222	Task of Interest 2	0 1 2 3 4 5 N/A N/O
223	Task of Interest 3	0 1 2 3 4 5 N/A N/O
224	Freeform 1	
225	Freeform 2	

APPENDIX B. REPORTS

1. Fire Support

FIRE SUPPORT EFFECTIVENESS

FIRE SUPPORT STATISTICS	ROTATION: 96-06 MISSION: DATK
PLATFORM TYPE: M198	START TIME: 060612 MAR END TIME : 060740 MAR
FORCE: TF 1/61 AR	COMMENTS: LFX, DAY

FIRE SUPPORT EFFECTIVENESS

	Artillery		Mortars	
	Missions	Rounds	Missions	Rounds
Total	3	95	2	146
Effective	1	29	1	69
Suppressive	1	39	0	0
Ineffective	1	27	1	77
% Eff/Supp	67%	71%	50%	47%

Source of Data

The data for this report are obtained from the Fire Support O/C card and the RDMS.

Purpose

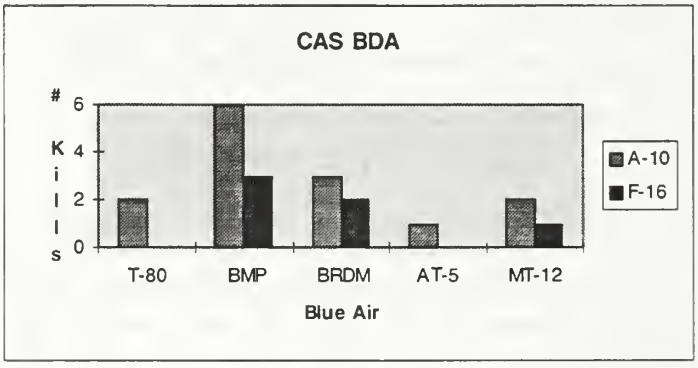
The purpose of this report is to show BLUEFOR units the effectiveness of their artillery and mortar indirect fire missions.

Potential Discussion Items

Volume of fire
Observation Plan
COLT emplacement
Scheme of fires in terms of task, purpose, method, and endstate
Integration of fires with ground maneuver plan
Indirect fire triggers
Employment of artillery and mortar smoke

CAS BATTLE DAMAGE ASSESSMENT

ENGAGEMENT BY TARGET	ROTATION: 96-06 MISSION: DATK
PLATFORM TYPE: A-10/F-16	START TIME: 060800 MAR END TIME : 060920 MAR
FORCE: TF 1/61 AR	COMMENTS



Source of Data

The data for this report are obtained from the RDMS.

Purpose

The purpose of this report is to show BLUEFOR units the effectiveness of Close Air Support (CAS) employment.

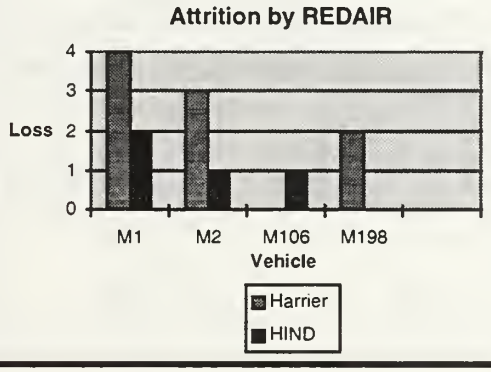
Potential Discussion Items

Integration of CAS within the scheme of fires
Suppression of enemy air defenses (SEAD)
Airspace Coordination Areas (ACA)

2. Air Defense

ATTRITION BY RED A/C

KILLS BY TYPE A/C	ROTATION: 96-06 MISSION: DATK
PLATFORM TYPE: Harrier/HIND	START TIME: 060630 MAR END TIME : 060740 MAR
FORCE: TF 1/61 AR	COMMENTS



RED Aircraft

	Harrier	HIND
Flown	12	4
Lost	5	3
Killed by	Stinger- 5	Stinger- 2 M2- 1

Source of Data

The data for this report are obtained from the Air Defense O/C card.

Purpose

The purpose of this report is to show the effectiveness of BLUEFOR combat and air defense units against enemy aircraft.

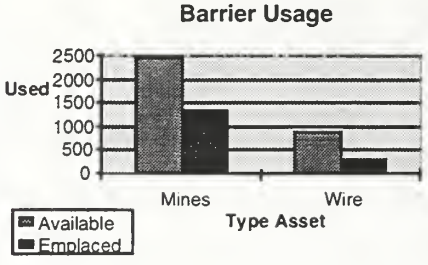
Potential Discussion Items

Aircraft recognition
Early warning
Air defense priorities
Detailed coverage plan integration within scheme of maneuver
Response to air attack
CAFAD

3. Mobility/Countermobility/Survivability

DEFENSIVE PREPARATION

COUNTERMOBILITY/SURVIVABILITY	ROTATION: 96-06 MISSION: DEF
PLATFORM TYPE:	START TIME: 051540 MAR END TIME : 062300 MAR
FORCE: TF 1/61 AR	COMMENTS: LFX



Fignting Positions

	Fighting Positions	Dug to Std	% to Standard
A Tank	10	6	60%
B Mech	12	10	83%
D Mech	9	7	78%
D Tank	7	3	43%
Totals	38	26	68%

Source of Data

The data for this report are obtained from the Mobility/Countermobility/Survivability (M/CM/S) card.

Purpose

The purpose of this report is to display the utilization of barrier and survivability assets.

Potential Discussion Items

Use of survivability assets
Hasty protective minefield emplacement and directed minefields emplacement
Engineer plan of platoon man-hours and refined timelines
Minefield reporting
Allocation of assets: countermobility versus survivability

4. Combat Service Support

OPERATIONAL READINESS

M1/M2 OPERATIONAL READINESS	ROTATION: 96-06 MISSION: MTC
PLATFORM TYPE: M1/M2	START TIME: 051540 MAR END TIME : 061035 MAR
FORCE: TF 1/61 AR	COMMENTS: FOF

OR RATE

	M1		M2	
	Assigned	Operational	Assigned	Operational
A Tank	10	7	4	4
B Mech	4	3	10	8
D Mech	8	5	10	9
D Tank	6	4	4	3
Totals	28	19	28	24
OR Rate		68%		86%

Source of Data

The data for this report are obtained from the Company O/C evaluation card.

Purpose

The purpose of this report is to show the effectiveness of BLUEFOR maintenance.

Potential Discussion Items

Maintenance system within task force
Preventive Maintenance Checks and Services (PMCS)
Parts ordering system
Tracking by Combat Trains and Field Trains Cps (Command Posts)
Employment of UMCP (Unit Maintenance Collection Point)
Vehicle recovery policy
Assets and CP positioning plan

CASUALTY STATISTICS

DOW VERSUS TOTAL CASUALTIES	ROTATION: 96-06 MISSION: MTC
PLATFORM TYPE: PERSONNEL	START TIME: 060600 MAR END TIME : 061035 MAR
FORCE: TF 1/61 AR	COMMENTS: FOF

DIED OF WOUNDS

	Total Casualties	DOW	% DOW
A Tank	14	11	79%
B Mech	26	6	23%
D Mech	33	9	27%
D Tank	9	2	22%
Totals	82	28	34%

Source of Data

The data for this report are obtained from the Company O/C evaluation card.

Purpose

The purpose of this report is to show the effectiveness of BLUEFOR medical evacuation an treatment systems.

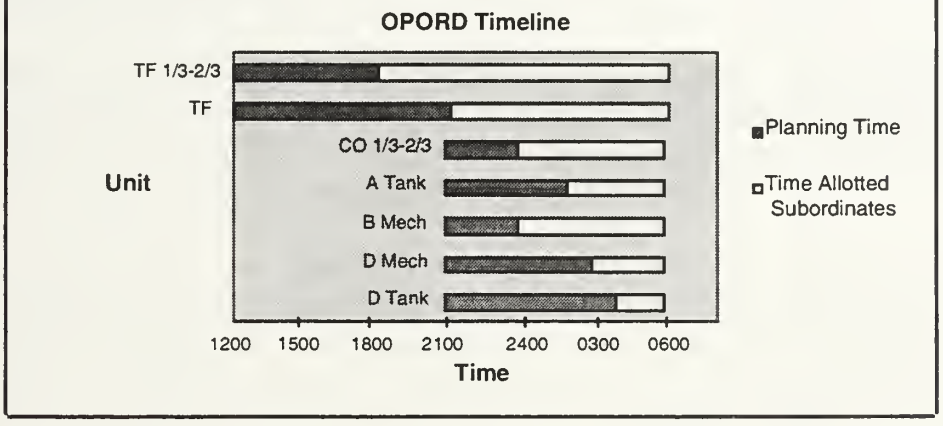
Potential Discussion Items

Use of Buddy Aid and combat lifesavers
Casualty evacuation policy
Casualty evacuation plan and mass casualty evacuation
Positioning and coverage of forward and main aid stations
Plan for chemically contaminated casualties
Casualty tracking

5. Battle Command

OPORD TIMELINE

TF PLANNING PROCESS	ROTATION: 96-06 MISSION: MTC
PLATFORM TYPE:	START TIME: 051200 MAR END TIME : 060600 MAR
FORCE: TF 1/61 AR	COMMENTS: FOF



Source of Data

The data for this report are obtained from Platoon, Company, and Battle Command O/C evaluation cards.

Purpose

The purpose of this report is to show the BLUEFOR units their use of time during the planning process.

Potential Discussion Items

Time management
Orders process
Abbreviated orders planning
Subordinate unit orders

GLOSSARY

Air Defense (ADA) - Operations that provide the force with protection from enemy air attack, preventing the enemy from separating friendly forces while freeing the commander to fully synchronize maneuver and firepower.

Battle Command (BC) - The art of battle decision making, leading, and motivating soldiers and their organizations into action to accomplish missions. Includes visualizing current state and future state, then formulating concepts of operations to get from one to the other at least cost. Also includes assigning missions; prioritizing and allocating resources; selecting the critical time and place to act; and knowing how and when to make adjustments during the fight.

Combat Service Support (CSS) - The assistance provided to sustain combat forces, primarily in the fields of administration and logistics. It includes administrative services, chaplain services, civil affairs, food services, finance, legal services, maintenance, medical services, supply, transportation, and other logistical services.

Fire Support (FS) - Fire support is the collective and coordinated employment of the fires of armed aircraft, land and sea-based indirect fire systems, and electronic warfare systems against ground targets to support land combat operations. Includes the integration and synchronization of fires and effects to delay, disrupt, or destroy enemy forces, combat functions, and facilities in pursuit of operational and tactical objectives.

Initiative - The ability to set or change the terms of battle; implies an offensive spirit

Intelligence (INT) - Intelligence operations are the organized efforts of a commander to gather information on the environment of operations and the enemy. Assembling an accurate picture of the battlefield requires centralized direction, simultaneous action at all levels of command, and timely distribution of information throughout the command.

Mass - Mass the effects of overwhelming combat power at the decisive place and time.

Maneuver (MAN) - The movement of forces supported by fire to achieve a position of advantage from which to destroy or threaten destruction of the enemy.

Mobility/Countermobility/Survivability (M/CM/S) - Mobility operations preserve the freedom of maneuver for friendly forces. Mobility missions include breaching enemy obstacles, increasing battlefield circulation, improving existing routes, and identifying routes around contaminated areas. Countermobility efforts limit the maneuver of enemy forces and enhance the effectiveness of fires. Countermobility missions include building obstacles and using smoke to hinder enemy movement. Survivability operations protect friendly forces from the effects of enemy weapons and from natural occurrences. Deception, construction of fighting positions, operational security, dispersion, and nuclear, biological chemical (NBC) defense measures are key survivability operations.

Surprise - Strike the enemy at a time or place or in a manner for which he is unprepared.

Versatility - The ability of units to meet diverse challenges, shift focus, tailor forces, and move from one role or mission to another rapidly and efficiently.

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